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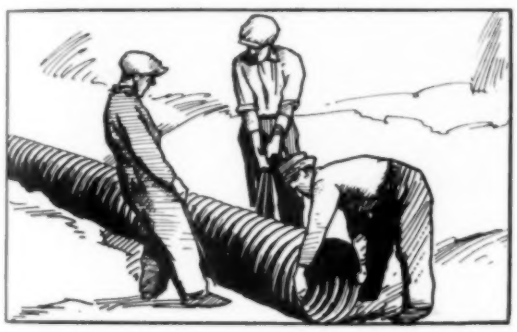
Cast Culverts Help To Keep Water Off Highways

WATER, necessary for the maintenance of life is one of the greatest enemies of highway and rail transportation for it makes roads impassable and undermines railroad beds thus impairing the safety of passengers and materials in transit. Drainage



Cast Corrugated Culvert Pipe Is Used in Many Drainage Systems

is a problem which highway and railroad construction engineers must meet and combat effectively. The installation of culvert pipe is a method used to eliminate that threat to public safety. The foundry industry has contributed its share to making good roads and safe transportation possible throughout the country by the manufacture of cast culvert pipe. One type is made somewhat on the principle of the bell and spigot pipe but in such a way that a short turn of the bell of one pipe tightens it to the spigot of any other. However, no attempt is made to make it water tight. Another type is corrugated and is made in such a way that two pipes screw together. Still another method is to cast the two halves separately with lugs on the sides so that they may be bolted together. Any of the above methods produce an excellent product that has long life and permancy, both of which are properties of all products of the castings industry.

Find Where Castings Can Be Sold

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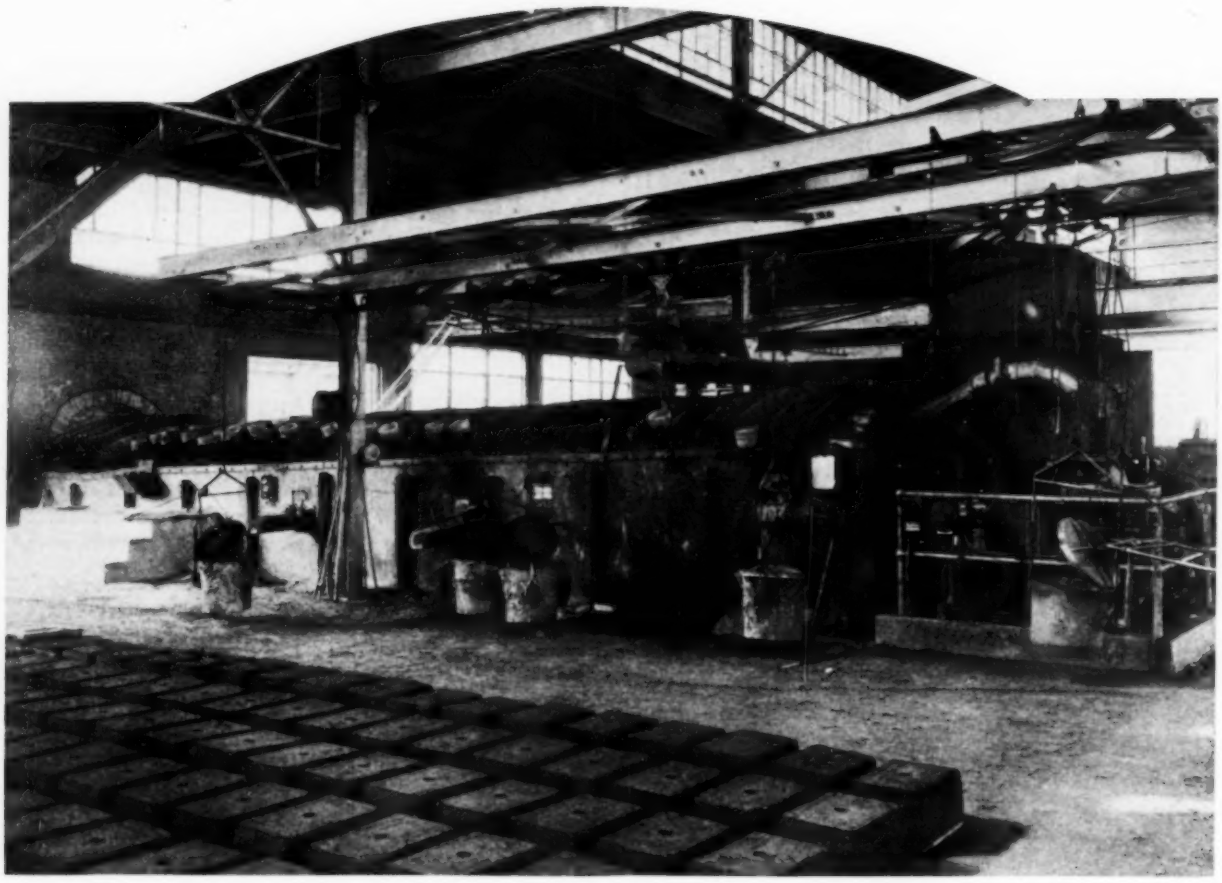


Fig. 1—Covered Bull Ladles Suspended from a Monorail Carry the Metal from the Furnace

AIMS AT PERFECTION IN

AMONG the many reasons which influenced the Columbia Malleable Castings Co., Columbia, Pa., to build a new plant, was the desire to have a plant in keeping with its product. Under the direction of the president, L. R. Zifferer, the company had operated an old plant for several years. This foundry had been old at the time Mr. Zifferer acquired it in 1917. Additions had been built on several occasions to cope with a constantly expanding business. Naturally under these conditions, no attempt was made to meet architectural beauty standards.

Finally when no further expansion was possible on the old property, when the insistent demand of current and anticipated business indicated that further expansion was not only desirable, but necessary, the company decided to erect, equip and operate an entirely new set of shops at a point near the Lincoln highway on the eastern boundary of the city and close to one of the numerous branches of the Philadelphia & Reading railroad. Thus incoming material and outgoing product may be handled by freight car and by the ubiquitous motor truck.

That part of the property between the buildings and the highway has been converted into a smooth emerald lawn, dotted with flower beds and ornamental shrubs and bordered by hedges that terminate near the highway in heroic size paintings depicting a molder, stripped to the waist, pouring iron from a hand ladle into a mold. Suitable flood lights at night impart life and realism to the stream of iron. The paintings are duplicates with the single exception that one man is depicted pouring right handed, while the other man is holding his ladle left handed which reflects usual shop practice.

General layout of the plant is shown in Fig. 7. A hollow square or court in the center containing the brass foundry, pattern shop, pattern vault, machine shop and boiler room, is bounded on the east by the foundry and on the west by the cleaning and annealing room. The wash room and core making department occupy the north side and the office occupies the center of the space on the south. Covered passageways connect the office with the two main buildings to the east and west. One of the advantages of

By Pat Dwyer

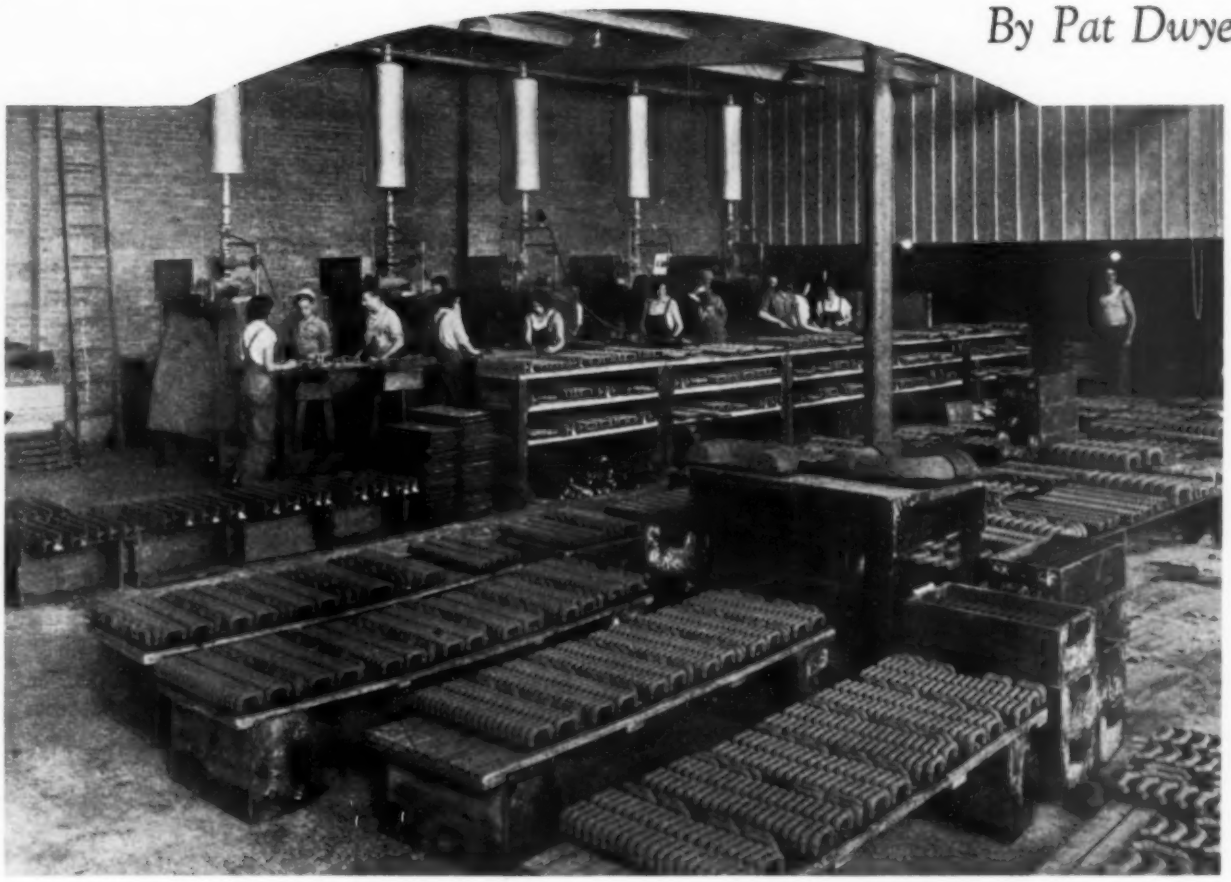


Fig. 2—Three Operators Attend Each of the Five Coremaking Machines in the Battery

MALLEABLE CASTINGS

this arrangement is that employes can enter and leave the cafeteria in the office building where meals are served at cost, without exposing themselves to the inclemencies of the weather.

Steel frame buildings, walled with red tapestry brick, faced with limestone and presenting a large expanse of windows, carry out the general motif of immaculate cleanliness which prevails inside and outside. A double monitor type roof with window sashes extending from end to end of the buildings supplements the windows in the walls and insures practically daylight lighting conditions over the entire floor area.

With the exception of the space around and occupied by the two air furnaces the entire floor space of 35,000 square feet in the foundry building is devoted to molding activities. Clay floors extend east and west from an 8-foot wide central concrete gangway. Four lines of molding machines of the pneumatic squeezer type are employed for making the molds for an extensive line of high pressure pipe fittings and accessories.

The comparatively large floor area, approximately 700 square feet per ton of metal melted, is due to the fact that all the molds are assembled on the floor before pouring commences. This condition, in turn, is due to the melting practice. The entire quantity of metal required is treated as a unit. It is melted down, brought to the desired analysis and temperature and then tapped in a practically continuous stream from both sides of the furnace. This and other features in connection with melting and pouring the iron will be taken up later.

One line of molding machines on each side of the building serves floors extending from the wall to a row of columns supporting the roof. A second line is located close to these columns and the molds are placed on floors extending from the columns to the central gangway. The continuity of the lines on the west side of the building is interrupted, as previously mentioned, by the two air furnaces which extend practically from the gangway to the west wall of the building. The circular brick stacks for the furnaces are located in the court outside the wall as may be noted in the illustration Fig. 7.

Fig. 3—Cores Are Transported on Trucks Equipped with Pneumatic Tires

Aluminum pattern plates with one-half the pattern on the cope side and one-half on the drag side are in universal use. The number of patterns on a plate, their disposition and the manner of gating constitute one of the major problems of production. Maximum output calls for as many patterns as can be crowded on the plate, but frequently the number must be modified to come within the fluidity range of the metal, and to meet other requirements.

Defects Cause Trouble

In addition to the usual hazard of cold shuts and misruns, incident to any attempt to distribute molten metal to a great number of small mold cavities in a single flask, other and more insidious forms of defect confront the manufacturer of high pressure fittings. Minute cracks, internal or external, or, small spongy areas of no moment in many lines of castings, are sufficient to condemn any casting made here. Absolute perfection, so far as it lies within the limitations of human achievement, is the slogan and watchword.

Micrometer inspection constitutes another limiting factor in several phases of the manufacture of these castings and this includes the arrangement of the patterns and gates on the pattern plate.

Manifestly patterns, coreboxes, cores and molds must be made with the greatest accuracy to meet such exacting standards. The skilled patternmaker can proceed cautiously to bring his pattern and corebox to the desired degree of accuracy, but his efforts may be nullified in the manner adopted in forming the cores and molds.

Cores may be distorted while in the green state and the molds may be distorted during the pouring process, if the sand between the individual castings is not sufficient in volume and density to resist the pressure of the metal, or if the outside of the mold is not reinforced adequately.

Instead of striving for a maximum number of patterns on a plate, the number is limited to meet the foregoing conditions. During the early or experimental stage, various types of flasks were tried on the smaller molds. The result has been the adoption of a tapered one-piece flask which strips from the mold. A tapered metal jacket is pressed down around each mold before the metal is poured into it. By shifting the jackets as the molds are poured, a small number will serve a floor containing from 100 to 200 molds.

To a person unacquainted with the peculiarities of malleable iron while passing from the molten to the solid state, the elaborate system of gating appears extravagant and wasteful. The amount of iron required to fill the gates and risers, equals, and in some instances exceeds, the amount in the castings. However, experience has shown it is an actual requisite to the production of sound, homogeneous castings, capable of passing the rigorous tests imposed, and of satisfactorily functioning in service.

The molds are dumped in a long windrow on the center of the floor and the castings are piled in the gangway. Later a lift truck picks up the castings and takes them to the cleaning and annealing department. Gates and runners, also castings sufficiently defective to be noticeable at this stage, are segregated and stacked at a point from which they easily may be lifted into the furnace on the following day. A sand cutting machine traveling under its own power, prepares the sand on the various floors.

Apply the Remedy

Pattern matchplates in nearly all instances conform to the general features illustrated in Figs. 8 and 9, where the cope side of the pattern plate is shown. The drag part of the mold, also shown in each illustration, indicates what the opposite side of the plate is like. In each instance the joint surface of the sand in the drag is shown projecting about ¾-inch above the joint of the flask. Examination of the pattern plate will show that a corresponding ridge will be formed on the cope side of the mold.

When the finished cope is placed upon the finished drag, this rectangular male and female joint holds them rigidly in place in relation to each other, and prevents a

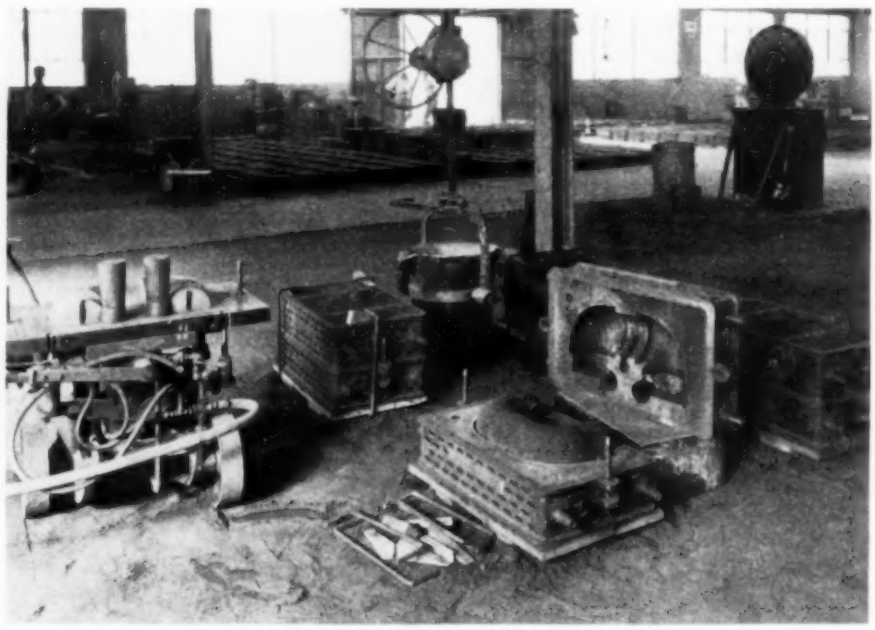


Fig. 4—A One-piece Core Eliminates the Need for Chaplets in Elbow Castings

shift during the removal of the flask, carrying the mold from the bench to the floor, or, while slipping the jacket around the body of sand constituting the mold.

Equipment and method for making the larger castings are shown in Fig. 4. In this instance since the pattern is symmetrical, one-half might have been served for molding both cope and drag. However, to facilitate production, one pattern is mounted on a cope machine, while a duplicate is mounted on a drag machine. The pattern for each of the two shrinkbobs is made in two parts. The part close to the pattern is attached to the pattern plate. The second, or loose part of the shrinkbob or riser, extends through to the top of the cope and is drawn upward before the cope is removed from the pattern plate.

Steel Flasks Used

After the sand has been rammed, the cope is raised away from the pattern by four pins, two on each side of the pattern plate. Usually it is not necessary to turn the cope. It is lifted from the machine and placed on the drag. One piece steel flasks, machined on the joint surface and fitted with accurately fitting guide pins, are employed for molding the larger castings.

The drag is molded on a rollover, jolt squeeze, pattern draw machine, mounted on wheels as with the cope machine, and thus readily moved from place to place on the floor as the day's work progresses.

Castings on the heavy floor are poured from a 1000-pound ladle equipped with a special pouring device to facilitate handling and suspended from a light monorail system installed over this section of the foundry floor near the air furnace.

Core sand is prepared in a 6-foot diameter muller for use in a battery of five pneumatically operated core machines. The sand is forced into the coreboxes under air pressure. Each of these machines is operated by mixed trios of boys and girls. Speed and deftness of the operators is reflected in a production of approximately 10,000 cores per day from each machine.

Most of the cores, as may be noted in Fig. 2, are turned out on flat plates and dried without the use of dryer shells. Double elbow cores with a single small wire in the arch, rest on the two outside prints. Small T-cores rest on one end print while the branch is supported against the vertical wall of an angle shaped core plate. The cores are dried in a battery of five drawer ovens and in two rack type ovens located a short distance from the core machines. All the ovens are fired with gas generated in a gas producer located in the yard and designed primarily to furnish gas for a continuous tunnel kiln type of annealing furnace located in an adjoining building.

A number of benches and two small jolt machines set up opposite the core blowing machines, are utilized for the production of cores that do not, for any one of a number of reasons, lend themselves to production on the battery of pneumatic machines. These reasons include large size, broken lots, short orders, peculiar sand mixtures and other special features.

Under normal operating conditions each melting furnace is designed to melt a heat of approximately 25 tons per day, using a com-

Equipment Was Supplied by Many Firms

A LARGE number of companies supplied the equipment used in the efficient and modern foundry of the Columbus Malleable Castings Co. The following list covers many of the important items:

Air compressors, Worthington Pump & Machinery Corp., New York.
Air furnaces, Whiting Corp., Harvey, Ill.
Annealing furnace, Swindell-Dressler Corp., Pittsburgh.
Core machines (jolt), International Molding Machine Co., Chicago.
Core machines (pneumatic), Wm. Demmler & Brothers, Kewanee, Ill.
Core ovens (drawer), Foundry Equipment Co., Cleveland.
Core ovens (rack), Gehnrich Oven Co., Long Island City, N. Y.
Cranes, Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.
Flasks, (steel), Fort Pitt Steel Castings Co., McKeesport, Pa.
Grinding wheels, Safety Grinding Wheel & Machine Co., Springfield, O.
Ladles (special), Modern Pouring Device Co., Port Washington, Wis.
Lift trucks, Yale & Towne Mfg. Co., Stamford, Conn.
Melting furnace (aluminum), Kindt-Collins Co., Cleveland.
Melting furnace (brass), Monarch Engineering & Mfg. Co., Baltimore.
Molding machines, Osborn Mfg. Co., Cleveland.
Monorail Systems, Cleveland Electric Tramrail Division, Cleveland Crane & Equipment Co., Wickliffe, O.; American Monorail Co., Cleveland; and Louden Machinery Company, Fairfield, Ia.
Powdered Coal equipment, Grindle Fuel Equipment Co., Chicago.
Sandblast, American Foundry Equipment Co., Mishawaka, Ind.; Pangborn Corp., Hagerstown, Md.; W. W. Sly Mfg. Co., Cleveland.
Sand cutter, American Foundry Equipment Co., Mishawaka, Ind.
Sand mixer, National Engineering Co., Chicago.
Scales, Toledo Scale Co., Toledo, O.
Tumbling barrels, Royersford Foundry & Machine Co., Royersford, Pa.
Water coolers, General Motors Corp., Detroit.

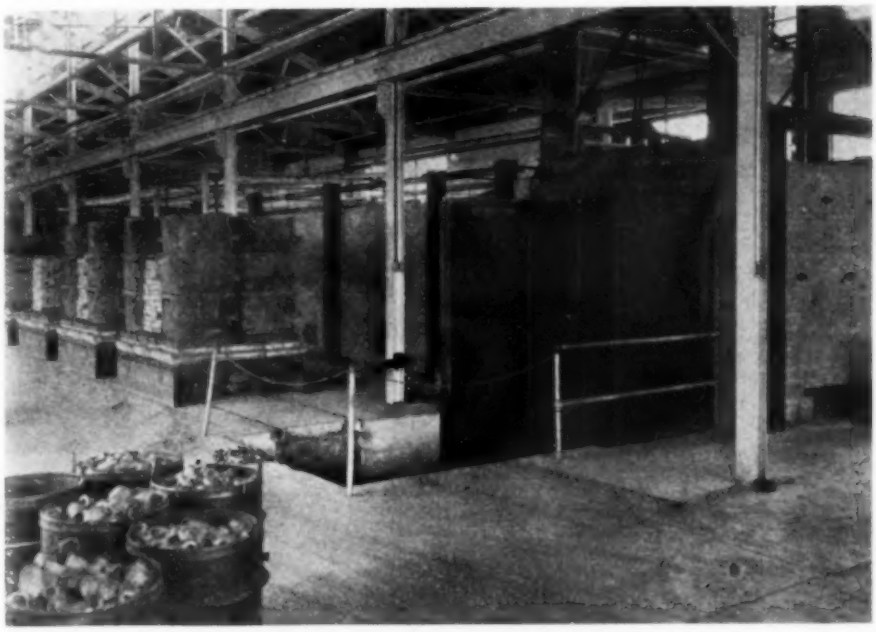


Fig. 5—Castings Are Annealed in a Continuous Type Oven Operating on a 120 Hour Schedule from Start to Finish

Fig. 6—Cleaned Castings Are Inspected in Front of the Tumbling Barrels

bination of oil and powdered coal for fuel. The coal is prepared in a small unit pulverizer located close to the firing end of the furnace.

Test bars taken from the metal melted under these conditions show the following physical properties: Tensile strength per square inch, 54,000 to 56,000 pounds; yield point, 36,000 to 38,000 pounds and elongation 18 to 25 per cent in 2 inches.

Each furnace is designed to supply one-half of the foundry with metal which is distributed in a number of 800-pound ladles provided with lids to conserve the heat and suspended from a monorail system above the gangway and extending to the ends of the building. Each monorail system with the necessary loops and switches near the furnace constitutes a self contained unit.

The castings are cleaned in a battery of nine tumbling barrels, elevated as shown in Fig. 6, for convenience in inspecting the cleaned castings preparatory to packing them in the annealing pots. The barrels are supplemented by a sandblast barrel and a cabinet type sandblast chamber for handling special loads. After the castings have been annealed they are passed through a sandblasting apparatus, thence to the sorting and inspection tables and finally to the shipping station or the machine shop where the respective operations are performed.

The castings are annealed over a period of 5 days in a continuous type oven with accommodation for 22 cars, each containing 18 pots and stacked 2-wide, 3-long and 3-deep. Each pot of cast bottom type holds approximately 500 pounds of castings, or 9000 pounds to the car load. In practice, one loaded car is removed from the oven at one end every 5½ hours and is replaced by another car at the other end. This system yields approximately 20 tons of annealed castings every 24 hours. The castings are packed in coarse silica sand or crushed quartz and a cover is sealed on each top pot before it is loaded on the car for a journey through the annealing oven.

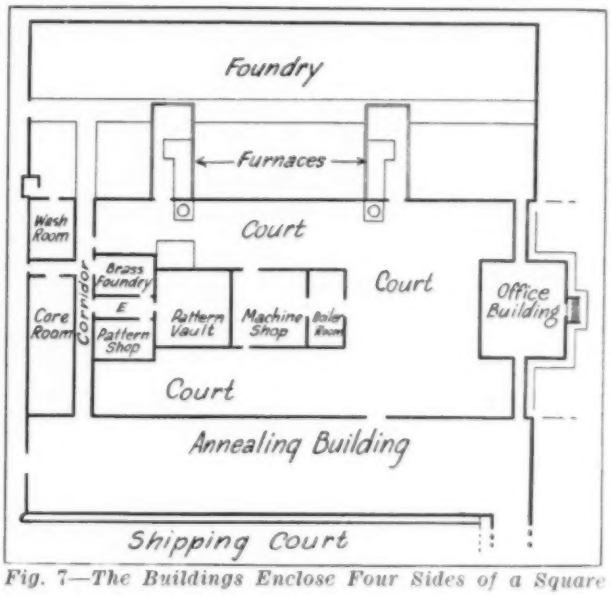
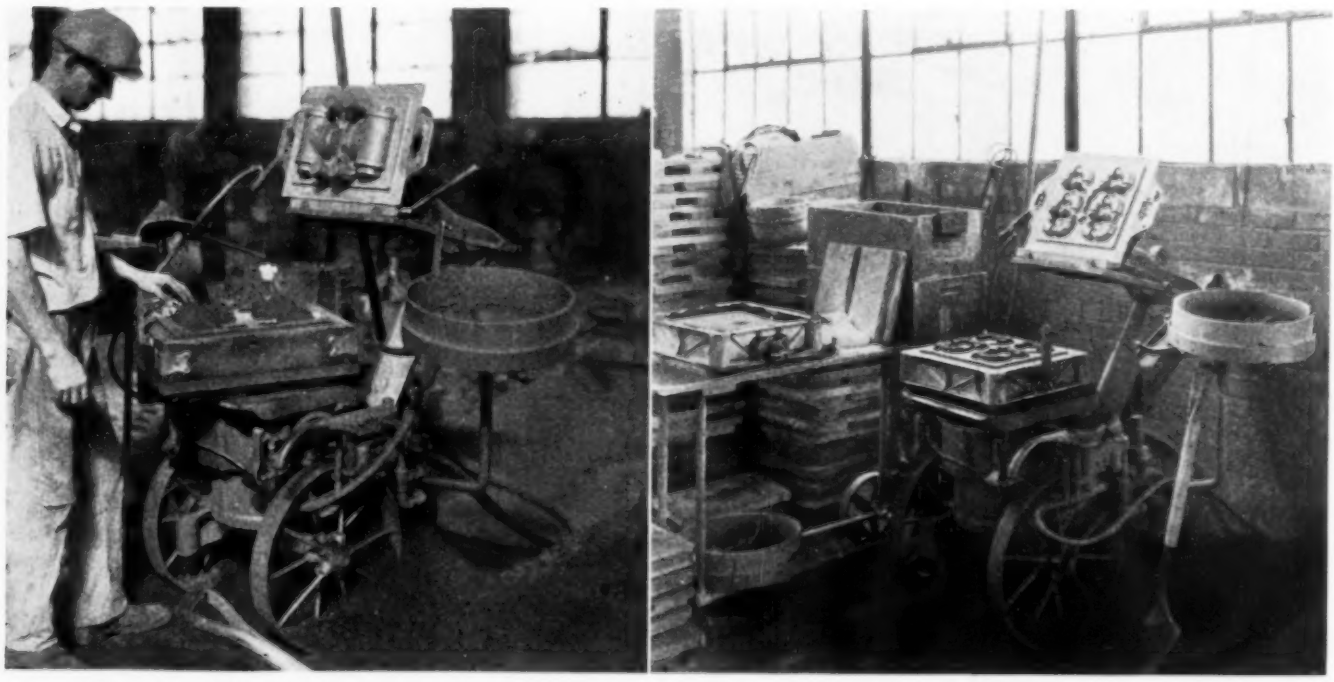


Fig. 7—The Buildings Enclose Four Sides of a Square



Figs. 8 and 9—Double Face Pattern Plates Are Employed. The Number of Patterns Depends on the Size

Each car passes through three temperature zones in the oven. In the first it is raised to and held at a temperature of 1700 degrees Fahr. In the second it is dropped to and held at 1400 degrees and in the third or last zone it is dropped still further to 1000 degrees at the beginning of the zone and to about 800 degrees at the exit. A sand seal on the side of the car holds the temperature under the car to not higher than 400 degrees Fahr., in the hottest zone of the oven. Elaborate pyrometric control permits close and accurate supervision and maintenance of uniform temperature conditions.

Interest of the management in the employes is seen in a well appointed wash and locker room equipped with a steam heater for drying the clothing, in a first aid station presided over by a full time nurse and visited daily by a physician, in a heating system which maintains a uniform temperature at all seasons, in cooled drinking water in fountains, in the athletic grounds and in the backing of various teams.

Ohio Association To Stress Safety

PLANS for the coming year were announced at the annual meeting and regional conference of the Ohio Foundries association held Nov. 13 at the Deshler-Wallick hotel, Columbus, O. The association will hold four formal regional conferences during the year, one each in the Cleveland, Cincinnati, Columbus and Toledo districts. In addition, three informal meetings will be held in each of the districts at regular intervals, thus providing four meetings, during the year in each district.

Various activities of the association were explained in detail by Robert Hoierman, secretary. The group has planned an all-year safety campaign in the foundries of the state to reduce the rates for compensation. After a series of conferences with a committee of the National Association of Purchasing Agents, at which minor changes were made, the trade customs of the Ohio Foundries association have been approved by the former group and now are up for adoption by the National Association of Purchasing Agents. The Ohio association also has established a traffic bureau and a central credit system.

Officers Are Elected

A. H. Kramer, vice president, Advance Foundry Co., Dayton, O., was elected president of the Ohio Foundries association; J. H. Bruce, Bowler Foundry Co., Cleveland, was elected vice president and Charles Seelbach, Forest City-Walworth Run Foundries, Cleveland, was re-elected treasurer. The following were elected to the board of directors for a term of three years: William Baker, Baker Bros. Inc., Toledo, O.; C. C. Erhart, Chris. Erhart Foundry, Cincinati; Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; Allan A. Nolte, Nolte Brass Foundry Co., Springfield, O.; and C. C. Smith, Toledo Steel Casting Co., Toledo, O.

A paper on "Industrial Accounting by Production and Operating Factors" by William A. Ullrich, cost accountant and engineer, Dayton, O., featured the morning program. Mr. Ullrich explained a system of accounting which was developed for use at the Dayton Steel Foundry Co., Dayton, O. Mr. Ullrich pointed out that by allocating every plant activity, it was possible to follow each cost easily and to visualize each activity in the establishment. He believes that any foundry activity, which is important enough to be used in the manufacture of a product, is of sufficient importance to be expensed and analyzed. Mr. Ullrich showed the method of preparing various reports made possible by the data obtained and stated that the shipping cost should not be included as a part of the manufacturing expense.

Records Are Important

Immediately following the luncheon, Frank W. Jackson, vice president, American Appraisal Co., Chicago, spoke on "Property Dollars—The Necessity for Their Control in Determining Production Costs and Profits and Loss." Mr. Jackson stressed the importance of adequate fixed property records to supply the following information: 1—Identity, location, origin and value of each major unit and group of minor units of fixed property, 2—Correct analysis and distribution of construction and installation costs, 3—Proper record for transfers of property units, 4—Proper analysis for maintenance and repair costs, 5—Proper consideration of depreciation through item rates or their equivalent, 6—Means of accounting for retirement of property, 7—Availability of data for operating cost analysis and distribution of overhead, 8—Consideration and check of construction budgets and appropriations, 9—Availability of property cost data required for income tax purposes, 10—The knowledge of the extent, use and value of the most important asset item, on the balance sheet. Mr. Jackson pointed out that obsolescense is the most important factor in depreciation.

An interesting motion picture showing the operation of the blast furnace in the manufacture of pig iron, was accompanied by a short paper on "Raw Materials in the Foundry" by Ralph H. Sweetser, assistant to the vice president, American Rolling Mill Co., Columbus, O. Mr. Sweetser stated that in both the blast furnace and the cupola, it is important that the coke used in melting have a low ash and sulphur content. Other similarities in blast furnace and cupola operation were pointed out. Both melting units require about the same amount of air to burn a pound of coke. Attention should be paid to the character of the air, for in both units, the cooler and cleaner the air pumped into the furnace, the less volume of air will be required.

The final paper on the program was presented by Y. A. Dyer, metallurgist, Birmingham, Ala., on "Phosphorus in Cast Iron." Mr. Dyer has conducted a large number of experiments during the past few years to determine the effect of phosphorus on various properties in the casting. Castings observed in this experimental work included cylinder blocks, valves, high pressure castings, oil field equipment, etc. Since hot metal frees itself of gases more readily, the iron should be 2700 degrees Fahr. at the spout. A generous coke bed should be used, as well as sufficient coke charges.

Relation Is Direct

In Part IX of the series on "Gray Iron Possesses Valuable Engineering Properties" which appeared in the Oct. 1 issue, reference was made to the equation $F = MA$ on page 83, second column, line 22. While it was stated that the energy indicated in the final drops is proportional to the square of the heights, it should be that the energy varies directly as the height. Consequently, the proportionality on impact will be 1 to 1.25 instead of 1 to 1.56.

The Austin Co., 16112 Euclid avenue, Cleveland, has opened a new Canadian branch of the company at 1307 Canada Permanent building, 320 Bay street, Toronto, Ont. The office is in charge of J. J. Lynch, formerly chief estimator.

Strong Aluminum Castings *Are Obtained by* Improved Foundry Practice

By T. D. Stay, E. M. Gingerich and H. J. Rowe

Part I

EVERY casting has certain functions to perform. To do this satisfactorily it must be strong enough for the purpose for which it is intended, and from an economical standpoint it must be as light in weight as its use will permit.

Certain sections of castings are stressed less highly than others. These sections may be made with thinner walls and less reinforcing ribs, provided the foundry will cooperate with the designer. By so doing, foundrymen can acquaint themselves with the functions of every casting and control the various foundry variables in such a way that the strongest metal is in the section of the casting receiving the maximum strains in service.

Molding Changes Properties

For example, five castings made from the same pattern can be made in as many different ways in the foundry and all will present the same surface appearance upon completion. However, on being subjected to physical tests approximating actual conditions, and X-ray examination, no two of the five castings will show the same properties. Which practice, then, should be followed in making these castings so that they will meet the design stresses, and how is the designer to know that his design is correct?

It is necessary to determine the effect of various foundry variables upon the strength of any particular casting, to find some accurate method of comparing their effect upon the physical properties. Several methods have been developed for determining the physical properties of castings, each of which has been considered in this connection, which are as follows: (1) By making tensile tests on individually-cast test bars. (2) By making tensile tests on test bars attached to the casting. (3) By making tensile tests on test bars machined from various sections of the casting. (4) By making breakdown tests on the casting as a whole.

It is apparent that, with the exception of the last method, the methods must be taken collectively to draw correct conclusions regarding the casting as a unit.

Before considering these methods individually, it is well to consider the general variables in foundry practice which affect the strength of a casting. These may be enumerated as follows: (1) The melting of the metal. (2) The pouring temperature of the metal. (3) The degree of chill imparted to the metal by the kind and temper of the sand. (4) The path taken by the metal through the mold after leaving the gates. (5) The rate of solidification in the various sections of the casting.

Ideal casting conditions are attained when the variables mentioned are regulated to give the highest possible physical properties in castings.

In the case of individually-cast test bars or castings of simple design, regulation of the aforementioned variables is relatively simple, and studies made as to the effect of these variables on test bars are invaluable if the improvements in test-bar practice are applied to the castings themselves. However, in the case of the more intricate castings, the control of these variables is a more difficult matter.

Individually-cast test bars, made in a standard green-sand mold without artificial chilling and under the same ideal conditions from day to day, can give the foundryman an accurate means of determining only whether the metal is, first, within the chemical specification for the particular alloy; second, properly melted; and third (in the case of heat-treated alloys), properly heat treated. Although individually-cast test bars do not show the strength existing in the castings themselves, nevertheless, by knowing the physical properties of such test bars certain conclusions can be made regarding the properties of the casting.

Relation Is Determined

Comparisons over a period of years indicate that test bars cut from castings made from the same metal and with proper foundry technique will have a minimum tensile strength of at least 70 to 75 per cent of that obtained on the individually-cast test bars. This relation between the tensile strength of individually-cast test bars and castings themselves has been obtained through numerous experiments in which test bars were machined directly from the casting for comparison.

It frequently is assumed that test bars or coupons attached to a casting are a means of determining casting strengths, and there still are some engineers who insist on their use. In many cases, to insure high strength in the attached test coupon by proper pouring and rate of solidification, strength must be sacrificed in the sections of the casting adjacent to the test coupon, because of the resulting draws or strains in those sections. Likewise, to insure high strength in the casting often means sacrificing strength in the test coupon which is attached to it.

Properties Vary

METHODS of molding a casting from the same pattern may vary to a considerable extent, and no two of the castings will show the same properties. Since the castings must withstand certain stresses, probably only one of the methods of molding will fulfill the requirements. To find the best method, some investigational work will have to be done as is explained in this article which is the first of two abstracted from a paper presented at the annual meeting of the American Foundrymen's association held in Cleveland, May 12 to 16, 1930. The authors are associated with the technical control and development section of the Aluminum Co. of America, Cleveland.

A consideration of the foundry technique connected with any particular casting will show readily why these facts are true. Castings with light and heavy sections require the proper placing of gates, risers and chills to insure the uniform rapid, progressive solidification necessary for maximum properties. The lightest section, farthest removed from the gates, governs the pouring temperature of the casting and may be considerably higher; or, in the case of heavy castings, it may be lower than the pouring temperature desired for maximum properties of individually-cast test bars.

This does not mean necessarily that the metal entering the various parts of the casting pattern cavity is either hotter or colder than the correct test bar temperature. The temperature of the molten metal as it fills various sections of the casting depends entirely upon the location of these sections with respect to the gates, and can be controlled to some extent by properly placed chills and the path of the metal over the sand walls of the mold or cores in reaching its final resting place.

Temperature Not Easily Controlled

However, the temperature of the metal entering the attached test-coupon pattern cannot be controlled so readily. If this cavity is near the gates, the metal temperature will be higher than if it were removed from the gates, and the physical properties will vary accordingly.

To obtain the true-strength of the various sections of a casting, test bars should be machined from these sections and tests made. In this way the weak sections can be determined and the necessary corrections in the foundry technique made to correct them.

That method of determining the strength of a casting is especially important in the development of the casting technique, for by properly placing the gates, risers and chills, the sections of the casting which receive the greatest stress in service can be made the strongest.

Although the tests of bars machined from the various sections of a casting may be useful in developing foundry technique, it is quite an advantage to make a proof load or breakdown test on the casting as a whole to prove out the design.

By so arranging these breakdown tests to approximate the conditions the casting actually will have to meet in service, valuable data can be obtained for the designing engineer. In some cases these conditions can be determined by the nature of the casting, while in others the designing engineer should supply the direction and loading of the stresses which have to be met.

Table I

Results of Physical Tests on End Plate

Bars cut from castings location	Casting No. 1 — Tensile strength, lbs. per sq. in.	Casting No. 1 — Elongation per cent in 2 in.	Casting No. 1 — Brinell hardness	Casting No. 2 — Tensile strength, lbs. per sq. in.	Casting No. 2 — Elongation, per cent in 2 in.	Casting No. 2 — Brinell hardness
1	32,900	2.70	72	28,900	2.70	62
2	28,600	2.70	68	31,400	8.00	65
3	31,400	4.00	72	31,400	4.00	62
4	28,600	4.00	72	26,500	5.50	59
5	28,600	4.00	72	27,500	5.50	65
6	28,600	2.70	72	26,700	2.70	62
7	43,250	6.70	65	28,900	4.00	62
8	41,500	8.70	65	32,850	12.00	62
9	27,500	4.00	68	33,400	10.70	65
10	33,200	5.40	62	28,600	4.00	59
11	33,800	6.70	59	31,100	2.70	65
Maximum	43,250	8.70	72	33,400	12.00	65
Average	32,450	4.70	68	29,750	5.60	63
Minimum	27,500	2.70	59	26,500	2.70	59
Individually—cast test bars	29,800	9.00	66	32,100	8.00	66
Attached test coupon	24,650	5.00	65	30,450	6.00	61
Breakdown test, failure in lbs.	.....	8,090	..	.....	7,110	..

Tests Are Repeated

After once determining the best foundry technique to produce the proper strength in the heavily stressed section of the casting proper, foundry control can be maintained by periodically repeating the breakdown tests.

Such tests as these give the manufacturer as well as the purchaser a far better working conception of the strength of the casting, than knowledge of either the strength of the individually-cast test bars, attached test coupons or bars cut from castings.

To show the relation between the properties of a casting as obtained by the several methods of testing, a typical case is shown in Fig. 1. This is a relatively simple casting, inasmuch as it is free from cores and intricate design features.

Table I gives the properties as obtained from separately cast test bars, attached test coupons, test bars machined from various sections of the casting and a breakdown test on the casting as a whole.

Two castings were made with slightly different foundry technique. In casting No. 1, the technique was developed to give maximum strength to the casting. The technique employed with casting No. 2 gave maximum properties to the attached test coupon but inferior properties in the casting.

Examination of the results show

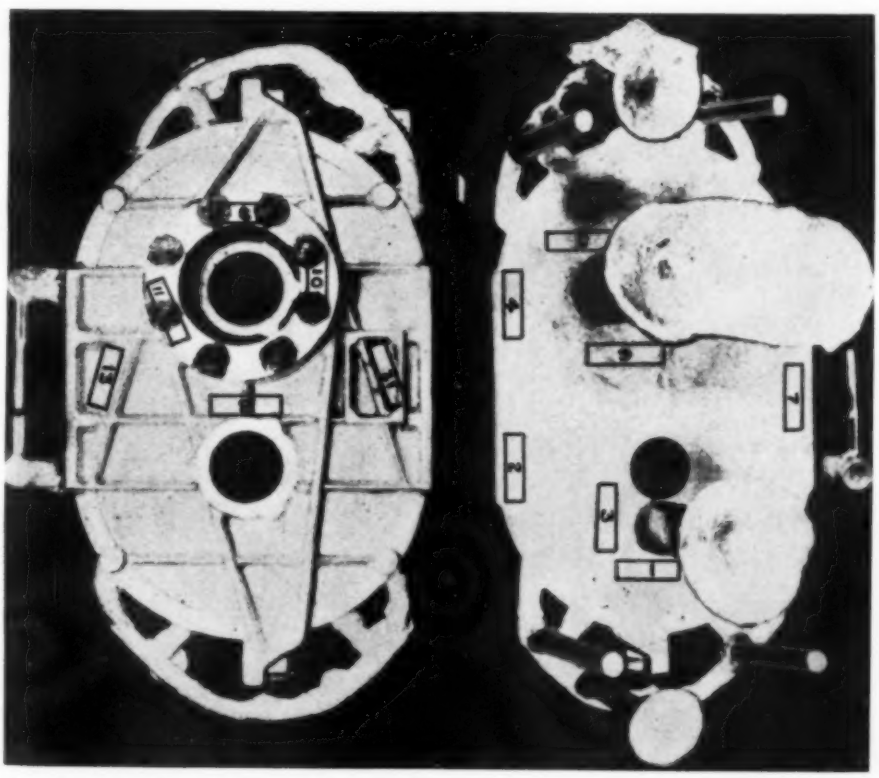


Fig. 1—Endplate for a Supercharger Showing Test Bar Locations with Reference to Gates, Risers and Chills. Chill Locations Are Darkened

Table II

Breakdown Test Data on Seat Brackets

Casting No.*	Alloy	Weight, lbs.	Static Test — Maximum load, lbs.	Static Test — Maximum def., inches	Section† increase per cent
1	195 HTT**	0.90	255	1.53	0.0
2	195 HTT**	0.99	390	1.35	8.0
3	195 HTT**	1.06	505	2.00	36.0
4	195 HTT**	1.10	515	2.50	6.50
5	195 HTT**	1.20	720	1.95	70.0

*Casting numbers refer to pattern changes in Fig. 2.
**Heat treated alloy containing approximately 4 per cent copper, 1 per cent silicon and 95 per cent aluminum.
†Per cent increase in cross section of casting at point of failure over the original cross-section of malleable-iron casting.

that the best casting, from a designer's standpoint, is not the one having the best results for the attached test coupon, in that both the average strengths of the bars machined from the casting and the breakdown load on the casting as a whole show the opposite results.

Since the external appearance of a casting often is misleading as to its internal soundness and hence its strength, it is quite desirable to investigate this condition in the development of casting technique. Radiographic examination by means of x-ray photographs affords an excellent aid in this respect. Internal defects such as shrinks, dross, porosity, inclusions, blowholes, and the like, can be disclosed more readily by employing x-rays than by the usual methods of machining or fracturing.

Castings Are Examined

Radiographic examination is particularly valuable in determining the soundness of highly stressed sections. These may be individual castings or merely the vital sections of large fabricated units.

Since an examination of this sort does not destroy or affect the casting in any way, it is quite adaptable as a means of inspection. In some instances it has been found advisable to x-ray all of a certain lot of castings, while in other cases a frequent check on castings taken at random from routine production is sufficient.

The chief value of radiography in the foundry is during the development of the foundry technique to be used in the routine production of castings. When used in conjunction with the various methods of determining the physical properties of a casting, radiography affords a relatively rapid means of fixing foundry variables.

It is the practice to x-ray the first few castings from every new pattern while making changes that seem desirable for increasing soundness of the casting. A study of radiographs will aid in telling whether the gates are properly placed, the effect of chills and risers on the porosity and will show any undesirable inclusions which may be present in the casting.

This examination, correlated with the physical tests made at the same time on the castings, gives the necessary information for improving the strength of any casting. Once a definite foundry technique has been established and the pattern is placed in routine production, the x-ray generally is used only for occasional checks.

One of the numerous examples of the use of the x-ray for casting development is shown in Fig. 2. This shows the original and final method of gating a relatively simple casting, with representative radiographs. The change in the gating of this particular casting resulted in a 50 per cent increase in the casting strength as determined by a breakdown test.

From the foregoing discussion it is evident that strength and uniformity in castings are closely dependent not on test bars—either individually cast or attached to the casting—but upon the proper correlation of foundry technique with the design of the casting. Some of the controllable variables in foundry technique will be described in somewhat more detail later.

All castings are designed with the idea of their answering a certain purpose or performing a given function. These principal functions of necessity must remain foremost in mind in the construction of the pattern for each particular casting.

This does not mean necessarily that only one design will fit each job, and it is not the purpose of this discussion to advocate any particular design for aluminum alloy castings. However, it is desired to bring out several design features whose use will facilitate the production of stronger aluminum-alloy castings.

It is well known that aluminum alloys have rather marked shrinkage and hot shortness characteristics, dependent to some extent on the type of alloy. Any design feature which, incorporated in pattern construction, tends to minimize the effect of these inherent properties will be well worth consideration.

Factors Minimize Effects

Generous fillets at all angles aid materially in reducing shrinkage and cracks at these points. Improper use of chills at these points many times apparently corrects the shrinkage on the surface but promotes columnar grain structure and develops a tendency toward cracks and internal shrinkage.

In gated patterns, match plates, cope and drag equipment, or any other patterns in which gates and risers are fixed in the pattern shop, care should be taken that metal does not enter the casting through those

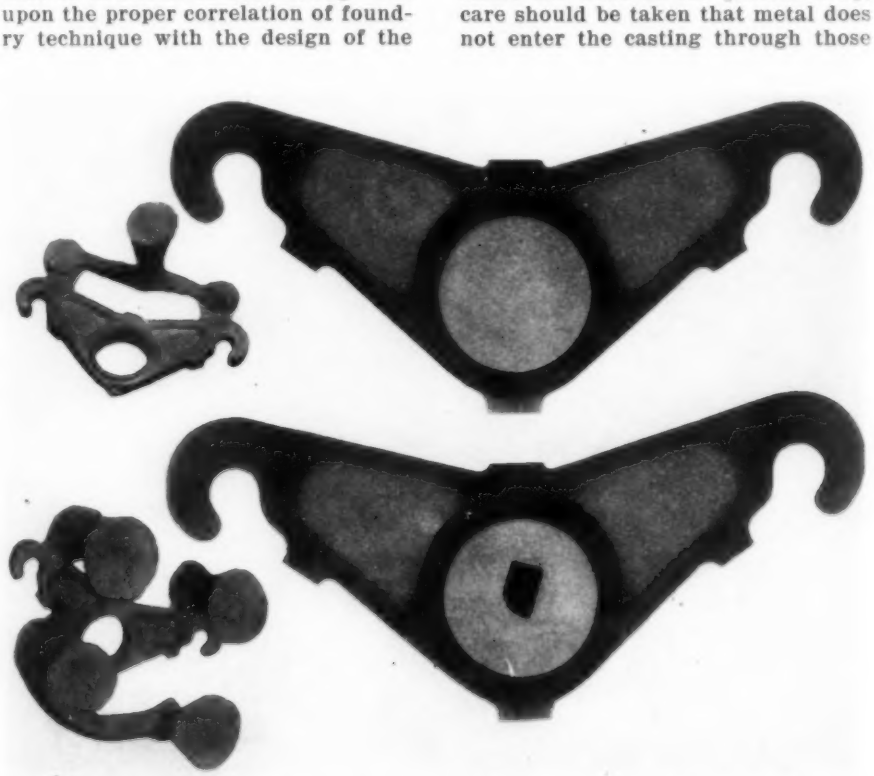


Fig. 2—Radiographs Showing Variations in Porosity Due to Gating. (Above)—Original, and (Below)—Adopted Method of Gating

sections which may become heavily stressed in service. Of course, the best locations can be determined more accurately before they are fixed for production, by physical tests in connection with casting characteristics. Such tests should include a breakdown test and determination of physical properties of test bars machined from the castings.

The avoidance of abrupt changes in wall thicknesses of castings decreases to a considerable extent the tendency to shrinks and cracks. When such conditions are necessary, provisions should be made to feed the heavy section by risers directly connected to them. Feeding is not satisfactory through thin sections into heavy sections.

Thin ribs and fins should be given considerable thought. In many cases, because of their rather rapid cooling, they may set up strains in the heavier sections of a casting, with the ultimate result that cracks may occur during heat treatment, machining or assembly. Sometimes these cracks may occur in such remote sections that their cause at first cannot be connected with a rib. It is worth while to check this condition whenever cracks are experienced.

Cast Face in Drag

Whenever possible, machined surfaces should be cast in the drag to eliminate as much as possible the presence of dross and porosity often present on the cope face. If a machined surface is made in the cope, additional finish should be allowed on the pattern to permit machining down to sound metal.

It is quite desirable that all of the above points be incorporated in core design also, as well as in pattern design. In addition, the following items should be considered:

Core prints of sufficient size, not only to give a suitable support for the core, but to permit easy escape of core gases, should be employed. This is particularly important in cores completely surrounded by metal, where insufficient means of escape for core gas developed in the mold may cause porosity and blow holes in the casting.

It is desirable to vent all cores to permit easy escape of the gases, generated on the interior of a core. Entrapped core gas often induces excessive porosity and is not desirable, at least in thin sections subjected to pressure requirements.

Patterns and pattern equipment formerly used for brass, bronze, cast iron and malleable iron often must be remodeled before they can be used satisfactorily for aluminum alloys. The necessary changes will vary with the particular casting and in general will result in increased sections and change of gating.

Patterns used to produce pressure-tight castings in ferrous and nonferrous metals often will require increased wall thickness when used with aluminum alloys. Aluminum alloy castings, to have strength equal to castings in these other alloys, often will have to have somewhat increased sections.

Just what increase in section is necessary is difficult to state, since this will depend upon the utility of each casting. However, the determination of these figures is made relatively simple through the use of breakdown tests upon the casting as a whole, in conjunction with the necessary pattern changes.

Fig. 3 shows the various steps used in the development of a heat-treated, aluminum-alloy, seat-bracket casting.

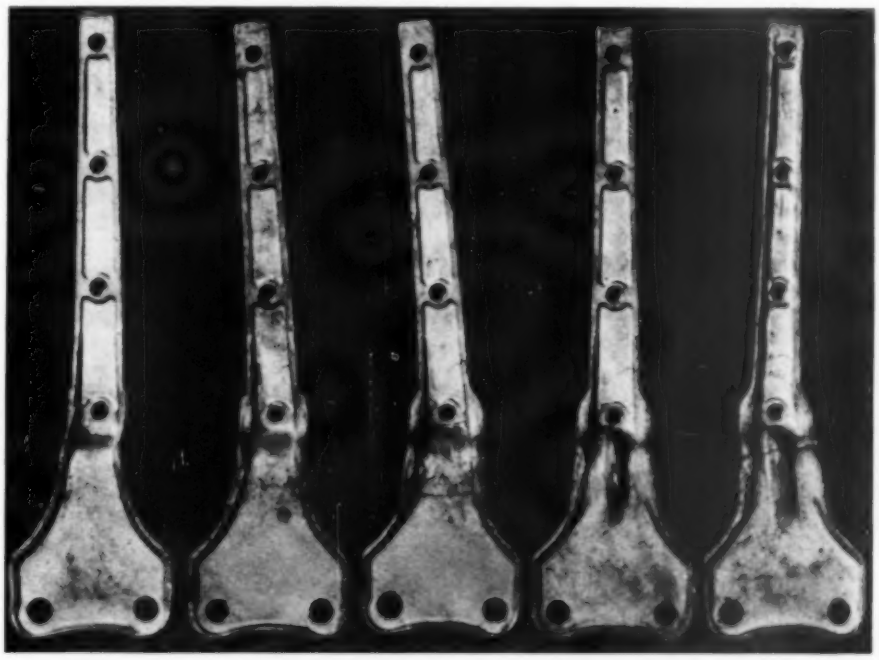


Fig. 3—Aluminum Alloy Seat Bracket Showing Steps in Pattern Development to Secure Strong Castings

Casting at the extreme left was made from an original malleable iron pattern and subjected to comparative breakdown tests to determine the points at which the failure occurred, so that section changes could be made on the pattern.

Since this particular casting is subjected to considerable impact as well as dead load, the tests were arranged to compare both these properties with those of the malleable iron. Intermediate changes in pattern design were made with wax on the original malleable-iron pattern, and castings were made for tests from each change until a suitable design was developed.

Table II gives the condensed test data as well as the weights of the various castings. When the final design is determined, permanent changes are made on the pattern.

Sand control in the aluminum foundry is an important factor in the production of good castings. Permeability, cohesiveness (as measured by compressive strength) and durability are among the properties of molding sand which determine its usefulness.

These, with moisture content, should be checked and controlled by routine tests. The effects of variations in the properties of molding sand upon the strength and quality of castings should be understood thoroughly and recognized.

An ideal molding sand for aluminum alloys is one which combines high permeability, compressive strength, durability and fine texture. Such a sand cannot be realized, since the great mobility and sand-searching power of aluminum alloys require the use of sands of fine grain. Therefore, sand penetration is prevented by sacrificing permeability in the finished mold.

Low permeability of the sand in a mold prevents the complete escape, through the sand, of gases and steam generated when the molten metal comes in contact with the sand. This often results in blow holes within the casting, or shallow depressions known as hard ram blows on the surface of the casting. Shrinkage on thin and more or less flat castings often can be traced to localized areas of low permeability.

Apart from the original character of the sand, low permeability in a mold may be the result of hard ramming, uneven ramming and high moisture content of the sand. Hard ramming has the effect of closing the pores in the sand, which prevents the ready escape of gases and steam and results in blow holes and hard ram blows.

In addition to its association with blows, low permeability resulting from hard ramming in certain areas may be the cause of a certain type

(*Concluded on Page* 103)

Gray Iron

Possesses

Valuable Engineering Properties

Part XI

MOST metals expand when heated, and contract when cooled. The fractional increase in any unit linear dimension per degree is called the temperature coefficient of linear expansion, while fractional change per unit volume is called the temperature coefficient of cubical or volume expansion. These coefficients may be expressed in either Fahrenheit or Centigrade temperatures. The Centigrade coefficient is 1.8 times the Fahrenheit coefficient for corresponding temperature ranges. Instead of using a decimal fraction the more common method of expression for linear expansion is inches per inch per degree divided by 1,000,000. For example if one inch of a material expands 0.0000025-inch per degree Fahr., its coefficient is expressed as 2.5 x 10^{-6} inches per inch per degree Fahr.

Contractions Affected by Changes

Metals expansions and contractions are due to: Change in volume with change in temperature; change in volume of solid with change in temperature, structure of metal constant; change in volume due change in state, for example from solid to liquid or vice versa, and change in volume due to change in constitution, for example expansion due formation of graphite in gray iron.

In absence of changes in state, allotropic modifications, formations of new components, and gas rejections, changes in length and volume proceed at an approximately constant manner, according to formulas of the types:

$Lt_2 = Lt_1[1+a(t_2-t_1)]$ (linear)

$Vt_2 = Vt_1[1+3a(t_2-t_1)]$ (volume)

where t_1 = initial temperature; t_2 = final temperature; L = length; a = a constant, the coefficient of expansion, and V = volume.

These formulas apply to isotropic materials, that is materials which possess like properties in all directions. All metals are anisotropic crystalline aggregates. However, as suggested by Portevin, "Metals are pseudo-isotropic aggregates of anisotropic elements," hence many possess approximately isotropic characteristics. However, in gray iron, the actual differences in structure between the outside and inside of a casting (for example) might be expected to exhibit a tendency toward anisotropic characteristics even in absences in change of state, etc.

That indicates a straight line relationship. In case of a complex material like gray iron such a formula is limited in application at those temperatures at which various structural changes occur. Nevertheless, the use of expansion and contraction data has proved of practical value to foundrymen as well as to engineers.

Gray Iron Contracts

EXPANSION and contraction of metals and alloys are due to several causes including a change from the liquid to the solid state or vice versa; to changes in constitution; changes in temperature, etc. Contraction in gray iron may be either of two types, namely liquid contraction or solid contraction. In foundry parlance contraction is referred to as shrinkage. Mechanisms involved in both types of contraction are explained in this article which is the eleventh of a series. The tenth article appeared in the Nov. 1, issue.

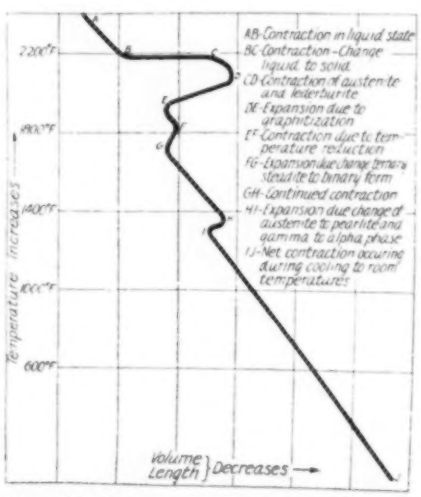

AB-Contraction in liquid state
BC-Contraction-Change liquid to solid
CD-Contraction of austenite and ledeburite
DE-Expansion due to graphitization
EF-Contraction due to temperature reduction
FG-Expansion due change tenary steadite to binary form
GH-Continued contraction
HI-Expansion due change of austenite to pearlite and gamma to alpha phase
IJ-Net contraction occuring during cooling to room temperatures
2200°F
1900°F
1400°F
1000°F
600°F
Temperature increases
Volume / Length } Decreases

Fig. 68—Diagram of Expansion and Contraction Effects in Cast Iron

All of us are familiar with the great work of Keep (started in 1885), Prof. Turner, T. J. West, and other pioneers in gray iron metallurgy, and the extensive use made by these men of data on dimensional changes. Of late years attention has been directed to the practical possibilities of dilatometric analysis. Recently the American Foundrymen's association has sponsored some work which now is being conducted at the bureau of standards on the *liquid shrinkage* of gray iron. Metallurgists expect much of practical benefit to be derived from that investigation.

Contraction Shown Qualitatively

Before going into detail some attention will be given to a qualitative diagram depicting what is known in a general way about the contractive phenomena of a gray iron cooling down from the molten state. This is depicted qualitatively in Fig. 68. In the molten state cast iron contracts in a constant and comparatively rapid manner until it commences to freeze. During solidification, represented by *BC*, there is a rapid and pronounced contraction. This represents the change in volume between liquid and solid at approximately constant temperature, and probably in some cases the rejection of gases, whose solubility may be much greater in liquid than in solid state.

Such a condition of affairs is quite common in some other metals and its possible occurrence should not be neglected in case of gray iron. The absorbability of gases in copper, shown in Fig. 69 illustrates this point. Eckman and Jordan have shown that the content of oxygen and some other gases in solid cast iron is negligible, but how about liquid cast iron?

From *C* to *D* the contraction of the austenite-ledeburite aggregate starts but soon is opposed by graphitization so that the net result *D* to *E* is expansion. From *E* to *F* contraction again sets in, but soon an expansion occurs *F* to *G* supposedly due to breaking down of tenary steadite to graphite and binary steadite. From *G* on contraction continues until at *HI* there is a marked expansion at the recalescence point (about 1350 degrees Fahr.) where the residual austenite changes to pearlite, and gamma iron

to the alpha form. From somewhat below that point or when graphitization has ceased, contraction proceeds at a constant rate to room temperature.

It would be fine if quantitative diagrams like the qualitative diagram were to be found. Although the general reactions are well known there are (to the author's knowledge) no quantitative diagrams covering the whole temprature range for different grades of iron, for various cooling rates, etc. Such data vitally is needed to make clear just how to produce the soundest and most dense castings.

In May, 1885, W. J. Keep discovered a relationship between the shrinkage (contraction) and the composition of a foundry mixture existed but it was not until publication of Prof. Turner's discovery that the condition of the carbon (degree of graphitization) depends on the proportion of silicon, that it was understood that shrinkage varies inversely as the silicon. The early work of Turner, Keep, and Moldenke led to Keep's attempts to correlate strength and other physical properties of gray iron with its contractive phenomena.

Square Bar Was Used

Keep's apparatus made an autographic record of the contractive behavior of a square test bar 1 x 1 x 24 inches between that temperature at which the metal has solidified sufficiently to move the pegs actuating the lever arms, and room temperature. Fig. 70 shows typical Keep contraction-cooling curves for irons of various silicon contents. At the base of the chart, time is plotted in minutes. Increase or decrease in length is indicated by raising or lowering of the curves, respectively in relation to the origins of the curves at the left. Keep's really brilliant work had the misfortune to be done at a time when methods of analysis for total carbon,

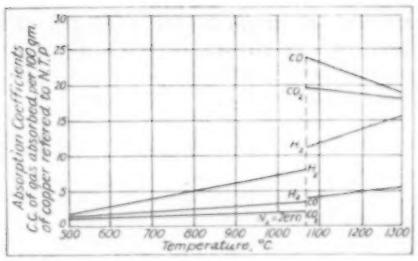


Fig. 69—Absorption Coefficients of Gases in Copper According to Iwase

pyrometric measurements, and apparatus for metallography were crude or nonexistent. Hence the quantitative interpretation of his work in light of present knowledge is not possible.

Keep's work greatly influenced the trend of metallurgy at the dawn of the twentieth century. However, the researches of Prof. Turner embodied pyrometric measurements and lead to more accurate interpretation. Typical curves are shown in Fig. 71 and as may be observed are time-contraction and not temperature-contraction curves.

Copper, a pure metal, shows relatively constant rate of contraction. The white iron shows one expansion later shown to correspond to the eutectoid transformation, austenite to pearlite, about 1350 degrees Fahr. The gray, low-phosphorus iron shows two expansions, the first immediately after the start of freezing, the second about the same place as that found on the white iron. The first expansion is due to the rapid formation of graphite, the second to the net effect of the eutectoid inversion, change of gamma to alpha iron and probably some graphitization.

The latter effect is manifest throughout the range from solidus to eutectoid, in the lessened contraction of the gray (graphitizing) iron. The top curve was obtained on a gray high-phosphorus iron. It shows the two expansions noted in the gray, low phosphorus, iron, and also an intermediate expansion after about 17 seconds. This is attributed to the formation of binary steadite in the high phosphorus iron. In Fig. 72 the contraction curve and the cooling curve for the high phosphorus iron are shown plotted on the same chart.

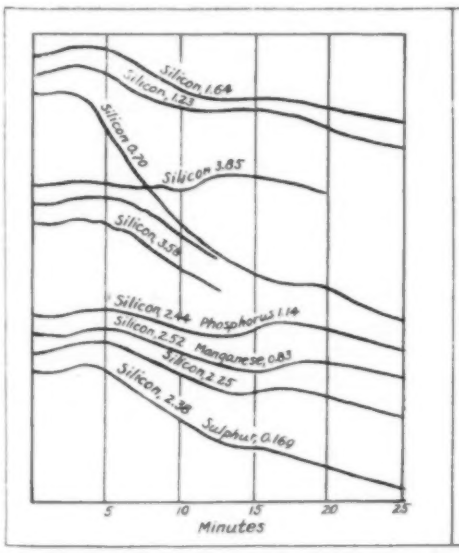
However, it is believed that the two upper transformations probably are too low, because of the rather quick cooling of the size bar used by Prof. Turner. This results in lag, and lowering in recording of transformation temperature. This was shown clearly by Bolton, International Foundry congress 1929, illustrated in Figs. 76 and 77. He shows depression of the initial point from 2063 to 1862 degrees Fahr. The former was obtained on a 3-inch test piece while the latter was obtained on a ½-inch bar. Naturally the 3-inch bar has more time to reach equilibrium than has the ½-inch bar; hence more chance to indicate the true condition of affairs.

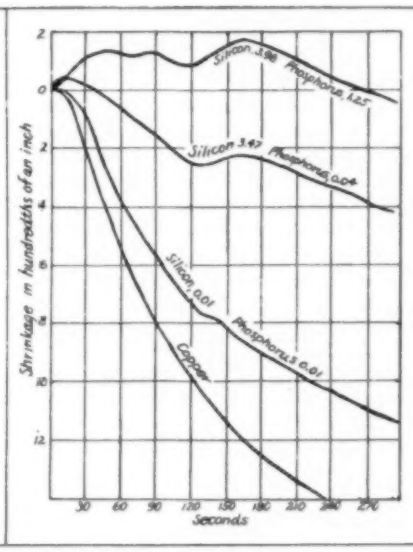
Elements Are Varied

More recently Bauer and Sipp carried out a number of tests to determine the effects of silicon, manganese, phosphorus and sulphur on the contraction and piping tendency of a Swedish charcoal iron, originally containing total carbon 3.35 per cent; silicon, trace; manganese, 0.20 per cent; phosphorus, 0.07 per cent and sulphur, 0.017 per cent. They made a number of crucible mixtures, changing the percentages of the elements other than iron and carbon. Their general conclusions are:

(1) Increase in silicon diminishes the linear contraction and generally tends to diminish the tendency to the metal to pipe. (Author's note—This does not coincide with the sometimes more marked tendency of some high silicon, steel-free iron to have shrinkage defects.)

(2) Increase in manganese di-





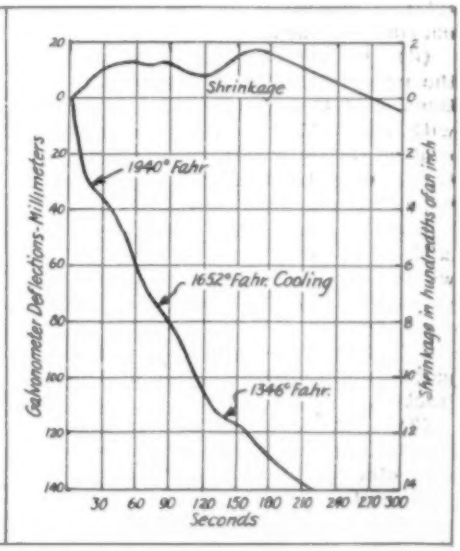


Fig. 70—Contraction Curves Determined by Keep. Fig. 71—Turner's Contraction Curves for Three Types of Iron and Copper. Fig. 72—Cooling and Shrinkage Curves for High Phosphorus Iron According to Turner

minishes the contraction and up to 1.20 per cent the tendency toward piping increases, beyond which it drops.

(3) Increase in phosphorus decreases tendency toward contraction and toward piping. (Author's note—Also disputed, particularly in American automotive foundries.)

(4) Increase in sulphur increases the tendency toward piping.

In 1928, Maurice Servais published an interesting study of shrinkage in an iron casting. He used green sand molds. Two gatings were employed; (1) pouring by gates attached to thin part of casting and (2) pouring by gate attached to a thick bar part of the casting. His conclusions are:

amount of graphite for example, silicon, which causes increase in total carbon with same combined carbon, etc., decreases the contraction.

(4) Conversely, the greater the combined carbon the greater the contraction.

(5) As a general rule in lower carbon iron alloys gradual reduction in total shrinkage is obtained by elements forming solid solutions, and beyond the limits of solid solubility there is a gradual increases in total shrinkage. Of course these effects are marked or reversed in gray irons by the effects of the elements on graphitization.

(6) The usual pattern makers rule

ment. At 2642 degrees Fahr. the density of the liquid is given by the empiric equation

Sp. Gr. = 7.16 — (0.1 Si + 0.07C).

The work on liquid shrinkage now being conducted by the bureau of standards and sponsored by the American Foundrymen's association is awaited eagerly by all interested in this subject.

Logically the solidification shrinkage, the contractions which occur between initial and final freezing, during the change from liquid to solid should be considered next. It is the phenomena occurring within this range that determine the tendency for the metal to form drawholes,

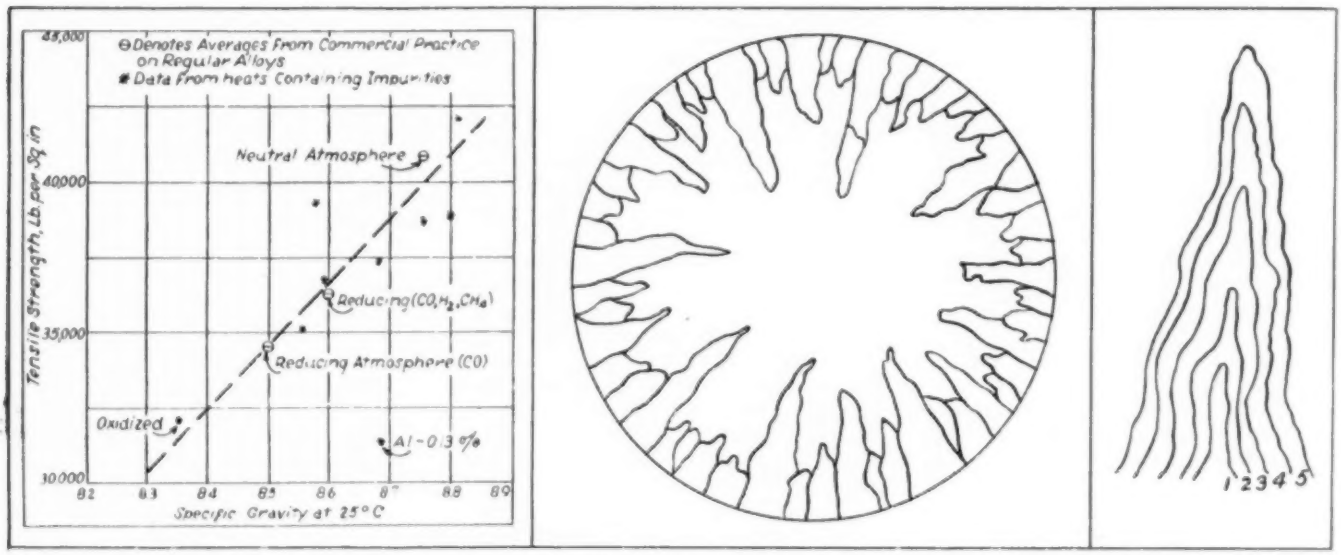


Fig. 73—Relation of Specific Gravity and Tensile Strength in Commercial Bronzes According to Bolton and Weigand. Fig. 74—Columnar Crystallization in a Cylindrical Cast Bar. Fig. 75—Diagrammatic Representation of Dendrite Formation

(a) The metal is malleable when hot (near melting point) and is increasingly elastic (nonplastic) as temperature becomes lower.

(b) The thin parts are more subject to contraction.

(c) Shrinkage can be promoted or retarded according to the method of pouring employed.

(d) It appears logical to begin the pouring through the thinnest sections, that these may be fed initially with the hottest metal, and the period of solidification (in point of time) may be nearly the same in both thin and thick sections.

Some general conclusions on the contraction properties of gray iron which may be drawn from the data presented and from general experience are:

(1) The higher the pouring temperature the greater the total contraction.

(2) Slower rate of cooling, that is heavier section, gives lower contraction, other factors equal, probably due the greater degree of graphitization plus the greater internal looseness of structure and pipe found in larger sections.

(3) Anything that increases the

allows for ⅛-inch per foot net contraction in gray irons and ¼-inch per foot in white irons. As a matter of foundry experience gray irons have been observed which, due to the effect of cores, of varying sections, of peculiarities of design, etc., apparently were nonshrinking. Net contraction in a complicated casting best is determined by experience and practice only.

Little has appeared in the literature on the true contraction in the liquid state of alloys of the gray iron class. Obviously liquid expansion or contraction cannot be measured in linear terms, but must be indicated as volume changes. It is evident that these changes can be calculated from specific gravity data—for specific gravity is related directly to specific volume.

Perhaps one of the most easily interpreted papers so far advanced is that by Schwartz. That investigator, working with irons in the range 2500 to 2700 degrees Fahr. found that within this range the coefficient of expansion of liquid iron was constant. That is, the liquid metal expands or contracts a definite increment for each equivalent temperature increshrinks or pipes, a matter of great commercial importance. Also, it is not only the visible shrinks that deserve attention. Incipient shrinkage undoubtedly promotes looseness of structure and weakness. The importance of this, not yet determined definitely on apparently sound gray iron castings, recently has been investigated in case of nonferrous cast metals by Bolton and Weigand. Fig. 73 shows the relation between specific gravity and tensile strength in a series of cast bronzes of similar analyses and crystal makeup, but with varying amounts of incipient (not visible to the eye) shrinks. Is it not surprising that variations of almost 30 per cent are found?

When liquid iron changes to solid there is a marked contraction occurring over a short range of temperature. The exact magnitude of this effect for various grades of irons remains to be determined. However, the general mechanism of such a reaction is pretty well understood. Let us consider a plain cylindrical shape, a bar 4 inches in diameter and 18 inches high. A cross section of the structure perpendicular to the major axis, will be similar to that shown in

Fig. 74. When poured into the mold the periphery, or the outside of the casting naturally freezes first forming a thin skin; the solidification proceeding progressively from the outside toward the center. However, as will be explained in a later section on heat treatment the portions lower in carbon crystallize out first, forming the familiar dendritic forms reaching inward as the fingerlike *columnar* crystals, depicted in Fig. 74.

Layers Are Deposited

The carbon-rich portion is rejected toward the center, the dendrites continuing to building up and reach in further as illustrated diagramatically in Fig. 75, the isothermals representing successive layers, each deposited at a definite temperature and richer in carbon than the preceding. Now, while that is going on in the interior, the outer portions of the section contract successively, rapidly at first. Then as they reach temperatures below the solid actually expanding somewhat as indicated in Fig. 68. When the carbon-rich portion has reached eutectic concentration it solidifies completely. Although solid, the material is still plastic, and further contractions or expansions continue to exercise their effects until viscosity reaches a point at which contractive and other forces cannot move the *crystals*.

The net effects are not easy to predict. They depend on the pouring temperature, size of section and other factors affecting cooling rate, the composition and viscosity of the metal and many other factors including gas rejection which must not be overlooked. If *feeding* is not employed the usual net effect in a large section is a spongy section or draw. In the example employed, a cylinder, let us see the effects of pouring temperature. Fig. 78 shows diagrammatic cross sections of two bars of the same size poured at different temperatures. In case of the hot pour the fluidity of the metal was sufficient to feed the lower portion, piping only at the top. Contrast the effect of lower temperature pouring shown in the bar to the left.

From the previous data and other considerations the following conclusions may be drawn:

(1) The tendency to *shrink* or form drawholes is largely a result of the differences in volume between liquid and solid metal and to differences in temperature in parts of the same casting. That *solidification shrinkage* probably varies with different types of iron.

(2) The magnitude of that tendency is affected by the freezing range of the casting. Slow cooling allows the time interval to make its effects most apparent. Thus thin plate castings have less tendency toward formation of shrinkage cavities than do heavy sections. It also is affected by the temperature interval between the initial and final crystallization (solidification range) of the metal. Eutectic mixtures solidifying at a single temperature rather than over a range should have less tendency toward shrinkage, other factors equal.

(3) Higher the temperature at which the mold is filled, the greater the total decrease in volume. However, many instances might be cited where hotter, more fluid metal will *feed* better, causing a larger pipe at the top of the casting or riser as shown in Fig. 78, but insuring more solid material beneath that portion.

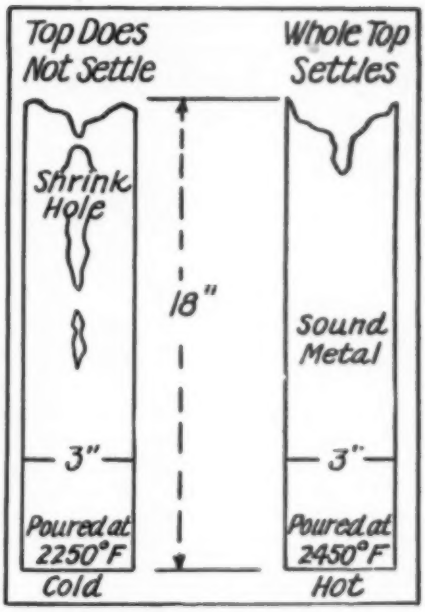


Fig. 78—Sketch Depicting Interior of Bars of Same Size Cast at Different Temperatures

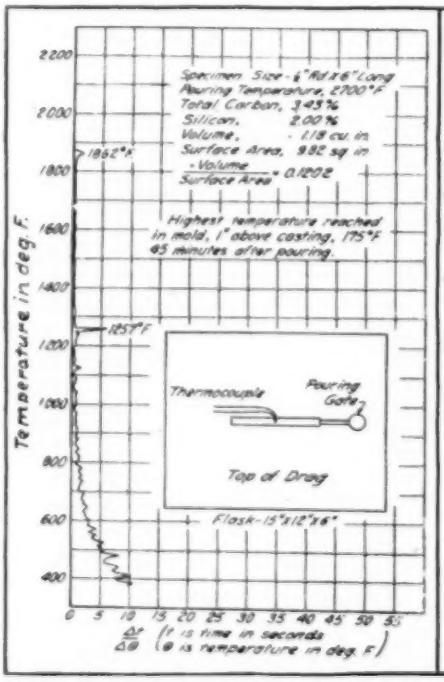
(4) Shrinkage defects and spongy areas are combated by one or both of two methods: (a) obtain uniform cooling throughout the casting; and (b) by feeding liquid metal to compensate for the metal drawn away by shrinkage effects. Among the expedients and methods employed to get sound castings, the first originates on the draftsman's board—*logical design* from a foundry viewpoint. Translated, that means *uniform* sections. More shrinkage defects, drawholes, and spongy spots are due to illogical design than to all other causes together. Thin sections directly adjoining heavy sections are frequent occurrences. To counteract such difficulty many foundrymen place chills or denseners adjacent the heavy sections, in an attempt to equalize cooling rates.

Molds Are Heated

One of the German processes for manufacturing high strength irons uses a heated mold. That in part is an attempt to keep the outside more nearly at the temperature of the interior and insure more uniform cooling across the section.

The slow pouring method advocated by Ronceray aims at getting uniform cooling across each section in an interesting manner. By restricting gates and pouring extremely slowly, each section is solidified progressively and by the time the mold is poured all but the last part is practically solid, hence shrinkage defects are avoided. At least one American foundry uses a method similar to this with good results. A 300-pound casting has a gate only slightly over ½-inch in diameter. The metal is melted hot, cooled to the desired point, and poured slowly. The cast-

(*Continued on Page* 103)


Temperature in deg. F.
Specimen Size - 6" Rd. x 6" Long
Pouring Temperature, 2700°F
Total Carbon, 3.45%
Silicon, 2.00%
Volume, 1.18 cu. in.
Surface Area, 9.82 sq. in.
Volume / Surface Area = 0.1202
1862°F.
Highest temperature reached in mold, 1" above casting, 175°F 95 minutes after pouring.
1257°F.
Thermocouple
Pouring Gate
Top of Drag
Flask-15"x12"x6"
Δt/Δθ (t is time in seconds, θ is temperature in deg. F.)

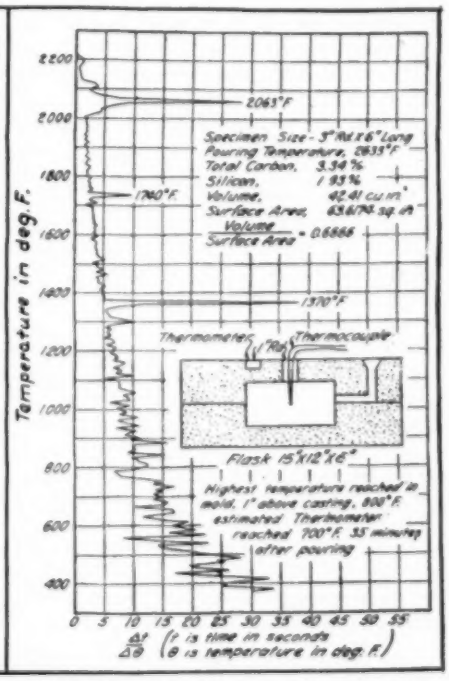

Temperature in deg. F.
2063°F.
Specimen Size - 3" Rd. x 6" Long
Pouring Temperature, 2833°F
Total Carbon, 3.34%
Silicon, 1.93%
Volume, 42.41 cu. in.
Surface Area, 63.6676 sq. in.
Volume / Surface Area = 0.6666
1740°F.
1370°F.
Thermometer
Thermocouple
Flask 15"x12"x6"
Highest temperature reached in mold, 1" above casting, 800°F. estimated. Thermometer reached 700°F. 35 minutes after pouring
Δt/Δθ (t is time in seconds, θ is temperature in deg. F.)

Fig. 76—Time-Temperature Curve for a ½-inch Test Piece. Fig. 77—Time-Temperature Curve for a 3-inch Test Piece

Synthetic Molding Sand

Requires a Proper Base

By L. B. KNIGHT

FIRE clay usually is taken from a pit or a bed, about 12 or 15 feet deep, or it is mined. The clay producer digs it out with a steam shovel or mines it and grinds it to a certain fineness depending on what it is to be used for. That variation in size should be the only factor which determines whether the clay is to be used or not. The quality should be the same whether it is for blast furnace work, or for bonding sand.

With the use of clay for lining ladles and for cupola work, the old method employed any clay that came along which was bonded with some loam from the back yard. Few foundrymen made chemical analyses to find the amount of lime in the loam or to determine its fusion point. They wondered why the cupola lining failed after a comparatively short time. If they had taken brickbats which came from the ladles and cupola, and ground and mixed them with a good fire clay, they probably could have doubled the life of the lining. A good mix for mudding the cupola or ladles is a 50-50 mix of brick dust and clay, the brick dust ground to about the same fineness as the clay. A highly plastic clay can be used for an even leaner mix. Some foundries use 75 per cent ground brick dust or silica sand. Others use a 60-40 mix.

Analysis Varies

The chemical analyses of good fire clays may vary widely. Silica from 50 to 65 per cent; alumina from 30 to 42 per cent; bond 3 to 4 per cent. Few clays contain more than 4 per cent iron. The iron pyrites reduce the fusion point of clay. Lime less than 1 per cent is seldom in the form of calcium carbonate. It is in the form of calcium oxide which will not flux with the iron. The magnesium oxide is around 0.5 per cent. The moisture loss on ignition varies widely from about 8 to 16 or even 20 per cent. The fusion point of a good plastic fire clay is about 3000 degrees Fahr. This wide range in silica and alumina percentage and moisture driven off has been a cause of controversy for a long time. The laboratory can make a fusion and chemical analysis of the clay and these values should be considered.

Explains Steps

THROUGH methods of sand testing it is possible to establish standards for sand control which will fit any particular need. With the standards established it is not difficult to manufacture a synthetic sand that will meet the individual requirements, according to the author. This article is abstracted from a talk presented by Mr. Knight at a meeting of the Wisconsin Gray Iron Foundry Group. The author is associated with the Illinois Clay Products Co., Joliet, Ill.

The final selection of the material to be used however, should be based on a test under actual service conditions in the foundry.

Natural molding sand is composed of silica grains, clay and water. Nature has coated every grain with a film of clay. Moisture wets the clay and the colloids in the clay cause the stickiness which enables the foundryman to make a mold for a casting. Synthetic sand is nothing more or less than those same silica grains, a little more uniform, perhaps, a good fire clay bond and moisture to cause the colloids to take hold. A mechanical mixer is used to coat the grains. With the proper base sand it should be possible to get a molding sand suitable for any particular job. All that is necessary is to establish a set of standards and then maintain the sand to give the results that are desired.

As far back as 1900, papers were presented on sand control and reclamation. Up to 1920 about 30 papers had been presented, and in 1920 the American Foundrymen's association committee on foundry sand research and sand reclamation was founded with certain subcommittees for tests. A report presented by that committee in 1928 recommended control tests and a detailed description of methods of procedure followed in making the tests. The tests recommended are: Permeability of the sand; strength tests; moisture test; sieve test or grain size; bond test; dye absorption test, and chemical analysis.

One of the first steps to start a rebonding program begins with the facing sands. Most foundries today use facings. That means it is not necessary to risk an entire heap to establish a bonding program. It can be tried on a particular job, and if it isn't satisfactory, change the facing, and cut and try until a sand is produced which meets the requirements. If the equipment necessary for making the tests is available and the approximate permeability, strength and moisture content is known it is a short step to obtain a proper base silica sand and determine the proper amount of clay to reproduce the new synthetic sand.

Moisture content is one important item to be considered in the use of synthetic sand. The legitimate range of moisture for a clay-bonded, synthetic sand is between 4½ to 5½ per cent.

Seacoal Is Used

A few specific jobs will be considered to see what has been done. An 800 pound casting, made on a sandslinging machine in a heap made up entirely of synthetic sand, has a gate which gives a nozzle effect and which, of course, results in burning in. The synthetic addition to the heap sand is made up of 10 parts of Ottawa No. 2 silica sand and 4 parts of seacoal, with 3 parts of clay. The standards maintained on this heap are as follows: Permeability, 75; shear strength, 1.6 to 1.9, and moisture, 5 per cent.

Another job, weighing 150 pounds also made on a sandslinging machine uses a standard addition as follows: Ten parts of silica, 3 parts of fire clay, and 1 part of seacoal. That particular heap has standards of permeability from 60 to 70; shear strength 1.3 to 1.5, with 5 per cent moisture. Facing sand is made by taking 32 parts of heap sand and adding four parts of seacoal and mulling it two minutes before adding water and three minutes after the moisture is added. That gives a permeability of 60, a shear strength of 1.5 to 1.7, with 5 per cent moisture. All of the sand is trucked to the mill. The clay, seacoal and silica sand is put in the mill and mulled

dry for 2 minutes. Moisture then is added by a spray and it is then mulled 3 minutes wet.

With heap sand additions, the more concentrated the mix the cheaper it is and the less it is necessary to mull. There would be little saving to take 90 per cent silica sand and 10 per cent clay and mull that over and add it to the heap. An effort is made to add either a 50-50 mix, which gives some pad, or sometimes two parts of sand and one part of clay mulled with 2 per cent moisture. In this way the clay gets a good chance to be distributed through the sand. This is spread all along the heap and then cut with a cutter.

Cut Heaps Dry

In one shop it was found that by cutting the heaps through dry first it was possible to reduce by 25 per cent, the clay necessary to maintain the standards of strength and permeability. As a rule, the addition of raw clay to the heap will mean clay balls, and that means scabby castings. The use of mechanical mixing gives the nearest approach to the best sand. In that same shop in the last 8 months the scrap loss dropped from 15 to 16 per cent to less than 5 per cent. It would be practically impossible to claim that saving is due to the use of synthetic sand, but it is an indication of what the use of synthetic sand does.

Whether reclaiming sand or using new sand, if attention is given to the sand a considerable amount of allied troubles which are keeping scrap piles of some size will be unearthed. The successful use of a rebonding material means, first of all, a satisfactory material to act as a bond. A number of these are on the market, any one of which has considerable merit. After that it is merely a question of adapting the use of that material to the particular conditions in the shop.

With the 800 pound job previously mentioned, the company complained about rough castings, burning around the gate. It was admitted that there was a certain amount of nozzle action around the gate, but it was thought possible to get away from that trouble. The sand was checked. The company had been running good castings for about 4 months and then started to get the rough castings. The sand was blamed, but no change in the sand could be found. That shop used blacking but did not have a mechanical agitator, and about two-thirds of the time the mold was sprayed with black gasoline and oil. The graphite was in the bottom of the bucket while nothing but colored gasoline was on the top. A mechanical agitator was installed and the trouble disappeared. There was something which was laid to the sand which had no relation to the sand whatever; a trouble which good supervision would have checked immediately.

Not a great deal has been said about control tests, but the importance of making control tests and of following up the results in the cleaning room should be emphasized. If the foreman would spend half an hour or possibly an hour a day in the cleaning room, sizing up the castings after they have been milled, and checking the surface with reference to the trouble that might possibly be coming from the sand and then checking up the tests on the sand for that day, it would not be long before he would see practically perfect sand conditions. It is possible, but it takes time and trouble. Every foreman should get a sheet showing the tests on his floors. Don't let them work in the dark, but have these tests available to the men who might need them.

Another shop is making castings running from 200 pounds to 100 tons. On the light jobs the sand mixture consists of 36 parts of heap sand, 5 parts of clay flour, 3 parts of seacoal, and 5 parts of silica sand. That gives a permeability of 65, a compression strength of 15, a shear strength of 2½ to 2½, and moisture of 4½ to 6 per cent. For the heavy jobs a mixture 36 parts of old sand, 5 parts of clay bond, 7 parts of seacoal and 10 parts of silica sand is used. That gives a permeability average around 75 with a compression strength around 15, a shear strength of 4 and moisture about 5½ per cent.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of The Foundry or of its editors.

To the Editors:

What is the reason that young men are not learning the molding trade as a profession as they did 30 or 40 years ago? There is not proper opportunity for advancement to compensate for hard knocks and dirty work which they are compelled to go through. After they have put in years of hard work and become experienced, they are considered too old just when their experience is most valuable. When an executive is appointed, many small foundries pick an unskilled man who has been working in the foundry because they think that he is a little cheaper than a good practical man. Many larger plants want a college man for foundry superintendent. How many of those men know the practical side of foundry work?

If foundry owners would give practical men an opportunity and place confidence in them, I believe the owners would be farther ahead. One method would be to compensate the experienced man for the money that he saves the company in a given period.

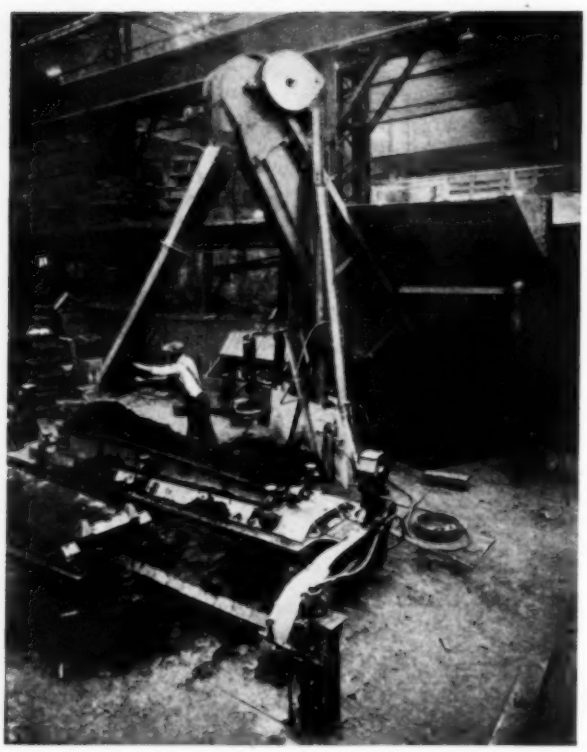
Other reasons why young men do not select the foundry trades as a life work are that other occupations often offer better wages and cleaner work. In my opinion, wages in the foundry have not advanced with other trades. High production and the molding machine have killed the molding trade to some extent, but good, skilled molders will be needed always and they are becoming scarcer every day.

As I see it, the only solution for such a condition is to give the practical man a chance at a better position. Molders should be paid better wages. Prices of castings should not be so low that the molder is required to work extremely hard to keep the firm from loosing money. The whole situation can be laid at the door of the foundry owner. One foundry will make castings at a given price and secure a small profit; another foundry will cut the price to receive its share of the work; still another will resort to the same tactics and as a result, none of them make much if any money. I believe that if castings were made on a time and material basis, the foundry industry would be in a better position.

How many men are capable of figuring a price of a job from a blueprint and know that the price quoted will yield a fair profit? I do not think that there are many. I have been in the foundry business for over 30 years and I do not think that I am quite capable although I could come closer than the majority.

George E. Carlin
14 *Rimbach avenue,*
Hammond, Ind.

"Investigation of the Thermal Conductivity of the System Copper-Nickel" is the title of a bulletin recently published by the Rensselaer Polytechnic institute, Troy, N. Y. While the thermal conductivity of the copper-nickel system previously has been investigated around 54 degrees Cent., the author G. F. Sager has extended the data to approximately 700 degrees Cent.



LAMP POST Design *DETERMINES* Molding Method

By Norman F. Hindle

Fig. 1—A Mold Filling Device Is Used in Machine Molding

IN RECENT years, civic pride has demanded that streets of American cities be well lighted. Lamp posts of various types have been designed to satisfy the requirements of utility and beauty. The familiar old wooden posts on either side of the street with a light hanging between them over the thoroughfare and those equipped with brackets to support the light have become a thing of the past in the down town districts of most American cities and are beginning to disappear in the suburban sections. In their place citizens see beautiful ornamental posts of varied design supporting large electric lamps enclosed in glass globes.

Lighting Equipment Made

Foundries have been called upon to manufacture standards to conform to design and quality demanded by lighting contracts for various cities. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is one of the large companies which has a special department devoted exclusively to the production of equipment for street lighting. The lighting division of that company formerly was located at South Bend, Ind. Recently it was moved to Cleveland and the manufacture of ornamental lamp posts was added to the Cleveland foundry of the company.

Two methods are used in the manufacture of gray iron lamp posts. Those which are fluted deeply, are rammed by hand while those with extremely shallow or no flutes are made on a jolt, rollover, pattern draw molding machine made by the Herman Pneumatic Machine Co., Zelienople, Pa. The machine will accommodate flasks 15 feet long for posts 14 feet in length. Three men operate the machine. One man acts as finisher and the other two place the flasks on the pattern plate and perform the necessary operations in making the molds. Cope and drag flasks used on that type work are 15 inches high at the base end and taper off toward the column end. The contour of the flasks approximates the shape of the post. Two holes are located in the base end of the flask for venting the mold. When the flasks are placed on the pattern plate, they are held in position by four clamps consisting of an arm which fits over the flange of the flask and is tightened in position by a heavy screw. The screw itself has holes around the circumference of the head in which a short lever is inserted to turn the screw. Cope and drag molds are made from the same pattern as the two parts of the casting must be symmetrical and identical.

Secure the Flask

After either the cope or drag half of the flask has been fastened securely in place, parting compound is shaken over the pattern and facing sand is riddled over the pattern face. In making the cope, that operation is followed by placing gaggers in the proper position. The number of gaggers used in a mold differs with the type of post being made. Some molds take a large number of gaggers while others require none. The flask is approximately half filled with backing sand delivered by a flask filling device made by the Osborn Mfg. Co., Cleveland. The sand is rammed well around the sides of the flask and lightly over the core prints with a pneumatic hammer. The flask is filled with sand from the previously mentioned device and jolted the necessary length of time to secure the desired mold hardness. The mold is struck off and the bottom board, which follows the contour of the flask, is bedded down, clamped to the flask and rolled over. The equalizing device is raised, the vibrator raps the pattern and the mold is drawn away from the pattern, while the pattern plate returns to the bed plate. The bed plate is machined to make the pattern plate bearing exactly level. Any sand left on the plate after a mold has been made is swept away before the pattern plate is lowered into position.

Chaplets Are Placed

The mold is finished while it is resting on the equalizer table. Required repairs are made, the mold is sprayed with a plumbago mold wash, and chaplets are placed in position. Extreme care is required in placing the chaplets. Points where they are located are shown in the mold by small projections on the pattern. The correct height of the chaplets is assured by the use of gages. After the mold has been finished, it is placed on the floor in position if it is a drag and the cores are set in the mold. If a cope has been made it is placed on a drag and clamped in position. Castings are gated through a skimmer gate to the bottom of the rim of the post.

The mold filling device consists of a large hopper containing sand for the day's work, a vibrator attached to the hopper, a conveyor and a chute. The conveyor is of the bucket type and is driven by a 20-horsepower motor. It is secured to the side of the hopper. The hopper is open along the section of travel of the conveyor so

that the sand falls into the buckets. The chute is pivoted on an axis at the top of the conveyor and may be swung so that sand can be delivered to any part of the flask. When the motor which drives the conveyor is started a solenoid valve also starts operating the vibrator. Thus the sand is vibrated into the bucket conveyor, carried to the chute and delivered to the flask. The machine has a capacity of 1 cubic foot per minute.

Natural bonded sand from the Sandusky district is used in the manufacture of lamp posts. New sand, added to the heaps when they are cut over by hand at night, keeps the sand in condition. The sand is conveyed to the hopper by grab bucket operated from an overhead crane. Moisture content of the sand is approximately 6.50 per cent; A. F. A. permeability, 25 to 28; and green sand strength, 1.0 to 1.2 pounds per square inch.

Daily output of lamp posts varies with the size being made. If 10-foot posts are in the sand, 23 constitutes a day's work, while 16 posts are made when 12 or 14-foot posts are produced.

Hand-rammed, lamp posts constitute an interesting job. The same pattern is used for the cope and drag molds and the gating is similar to that of the machine made molds. The plate on which the pattern is mounted, contains a groove running lengthwise through its center. The length of the groove corresponds to the length of the post being produced. The pattern is made of aluminum and is hollow with reinforcing bars lengthwise centrally in the column pattern and crosswise of the base, one near the point where it joins the column core and the other at the opposite end near the core print. Small projections are located on the cross bars. These projections fit in the groove and thus center the pattern on the plate.

Has Several Pieces

One piece patterns are used for making post castings on the machines while patterns used in hand molding consist of the base and three loose pieces; the column and four loose pieces; and the print for the column end of the core. Flasks used in that work conform to the same specifications as those used on the molding machines. Flasks are centered on the pattern plate with the aid of guide pin holes in the ends, through which bars are inserted. When the flask has been located in position, the pattern plate is clamped to the flask and the molding operations begin. Parting compound is shaken over the pattern which then is covered with riddled facing sand. The flask is filled with backing sand, tramped and rammed with a pneumatic rammer several times until it is completely filled. Sand is rammed well around the sides of the flask and over the pattern but more lightly over the core prints. After the mold has been filled, excess sand is loosened by the strike-off. Gaggers are inserted under the strike-off at both ends and then it is drawn across the mold to remove the excess sand. The gaggers run along the side of the flask and give an even amount of sand on the mold that is used to seat the bottom board firmly.

The bottom board is clamped to the flask and the crane lifts the flask and rolls it over with a special hook. The apparatus used to handle the flasks consists of an I-beam suspended from a single crane hook ring by two chains attached to either end of the beam. Two other chains equipped with rings that fit the flask trunions, hang from either end of the beam. The chain used to roll the flask over has a hook on the end which fits the flange of the flask. The hook is fastened to the upper flange of the flask, the chain is passed under the flask and hooked to the crane from the opposite side. When the crane hook is raised the mold is rolled over. The crane used for that work has two hooks. The larger is used to handle the mold and the smaller to turn it. Following that operation, the mold is placed on the floor.

After the mold has been rolled over, clamps holding the pattern plate to the flask are loosened and the plate is lifted off and placed ready for another flask, the pattern remaining in the mold. The molder slicks the mold and around the pattern and then swabs it. First, the base section is removed and then the central column section and the core print in turn. Loose pieces are withdrawn, first the side sections on the base and then the bottom section. These are followed by the four loose pieces that make

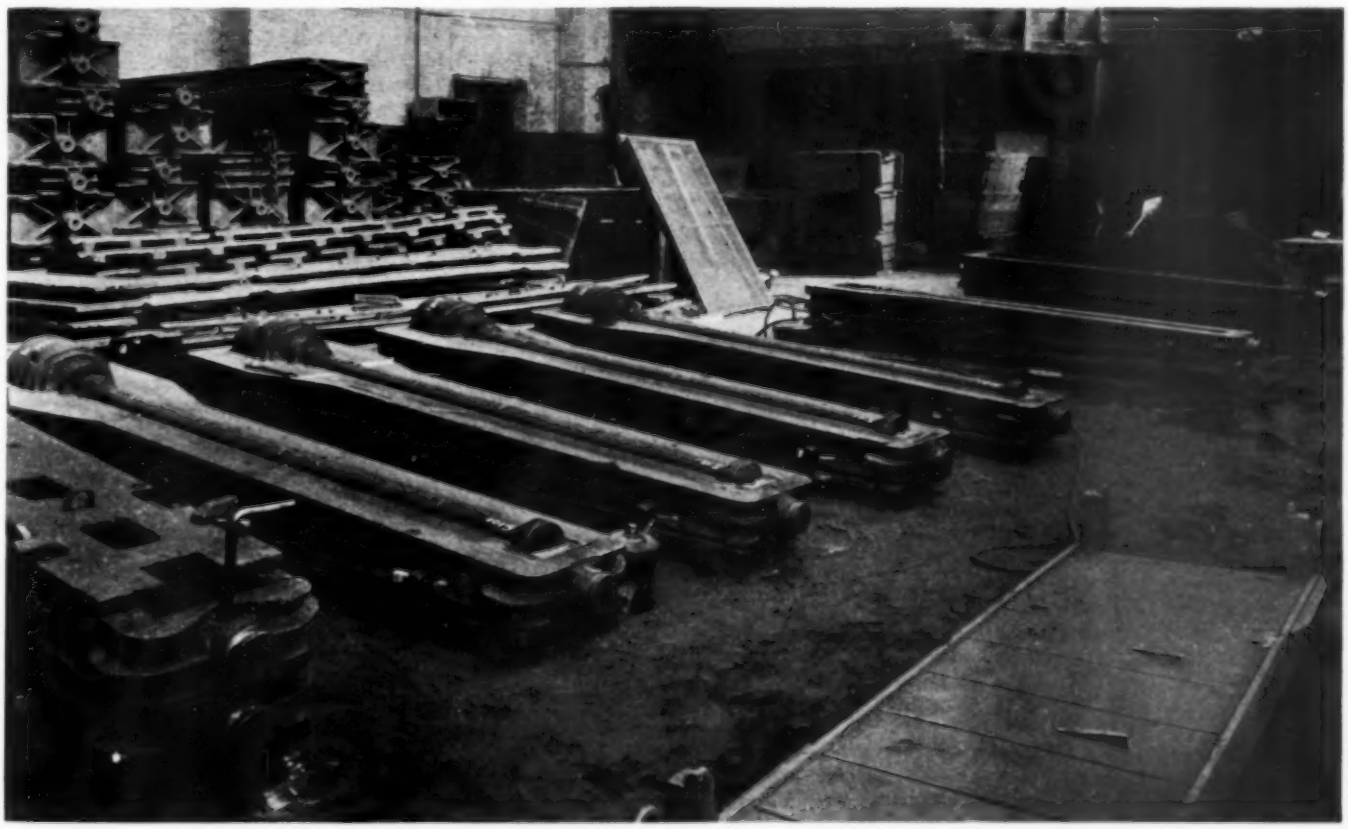


Fig. 2—Fluted Posts Are Molded by Hand, and Present Some Interesting Features

the flutes in the side of the column.

After the pattern has been withdrawn, the molder finishes the mold and sprays it with a coating of plumbago. The number of chaplets to be used depends upon the size of the casting being made. Patterns for the various sized posts are equipped with small projections at points where chaplets are to be located and these projections leave indentations in the sand when the pattern is removed. Thus chaplets are located at the same points in each mold and also are lined up in both the cope and drag. Base and column cores are separate and are set in the mold separately. One set of chaplets is located a few inches from the end of the base core away from the core print, another set supports the column core a few inches from the joint of that core and the base core, and the remainder are placed at intervals of about a foot along the column core. Chaplets are tin plated and the height is regulated by a set of gages. Other chaplets are similarly located in the cope and at the correct points along the sides of the mold so that the cores are lined up perfectly.

Gives Core Mixture

Cores are made from a mixture containing approximately 1 part core oil, 12 parts cereal binder and 52 parts silica sand. Cores of various sizes and designs are made, depending upon the pattern selected for the posts. Special core boxes are used for each design. As has been stated the castings are gated through the base core so the different core boxes must be used for cope and drag. Base cores are well rodded and rammed. Two large vents are made by locating brass rods in the core during the ramming. The rods are placed in the core so that the vents meet at approximately the same place in each core. The rods are located in the same manner in each core by holes in the print ends of the core box. The vent rods are withdrawn before the half core is placed on the core plate prior to being baked in the oven. However, before they are removed the coremaker scoops a small amount of sand from near the inner ends of the rods and thus makes an opening at both ends of the vents.

The cope part of the core is made with a single hole through it to form the cope part of the sprue. The drag follows the same general specifications as the cope with regard to venting and coremaking. However, a cast iron cup somewhat the shape of a horseshoe, varying in size and height, is rammed in the parting face of the core and a wedged shaped piece of steel forms the gate. The casting is gated inside the bottom of the base through the one gate. After the drag core is rammed, the cup and the gate piece are removed, and the core is placed on a core plate. Following a spraying with a plumbago wash, the base cores are baked overnight at a temperature not exceeding 400 degrees Fahr. The following morning they are removed from the oven, cooled and pasted together.

Wire is wound around the end of the completed core and twisted to hold the two halves securely and accurately in position. Excess wire is used to make a loop by which the cores are handled by the crane when they are placed in the mold.

Column cores are made, dried and pasted in somewhat the same manner. However, they are not sprayed with plumbago. When the base cores are placed in the mold, the cope vent holes are closed at the print ends but have contact with the drag vents because of the opening made at the ends of the holes as previously described. The entire mold is vented through the drag base core. No other vents are made in the mold. When the base cores are placed in the mold the finisher scoops out some sand back of the base core print in the drag mold and inserts vent wires through the holes in the flask previously mentioned and lines them up with the vent holes in the core. He then slicks the sand back in place leaving the vent wires in position. The same practice in venting is followed in making the machine molds. Vent wires are removed before pouring. As can be seen from the permeability number, the sand used is open. No trouble has been experienced with that method of venting.

Iron used in the posts is a 10 per cent steel mixture. Pouring temperature depends upon the size of the casting.

A.F.A. Recommendations Are Discussed

Members of the Chicago Foundrymen's club considered the tentative recommendations of the American Foundrymen's association committee for operation of a 54-inch cupola at the regular monthly meeting held Nov. 6 at the Chicago City club. Changes and additions were suggested and several members of the Chicago organization plan to submit further suggestions in writing to the association committee.

Comment on cupola lining included suggestions for fireclay mixtures and it was urged the recommendations should include daubing methods and mixtures. The consensus of opinion was that the use of breast brick apparently is most practical, despite the successful use of clay. Tuyeres, bottom sand, lighting-up, charging, flux, blast, and other recommendations also were discussed.

It was suggested that bottom sand be carefully screened so that all iron particles are removed, and that a moisture content of not over 5 per cent should be specified. Method of ramming also was regarded as important. Height of the coke bed above the tuyeres should be specified at 30 to 40 inches instead of 40 to 50 inches, it was suggested. Some exceptions were taken to the tentative recommendation of 6 to 24-ounce cupola blast pressure on the grounds that closer limits might be specified, resulting in a less variable range.

President H. P. Evans presided and turned over the discussion to the leadership of David G. Anderson, Western Electric Co., Chicago. Gottfrid Olson, former foundry superintendent, Illinois Malleable Iron Co., Chicago, who has been in Stockholm, Sweden, for the last three years as general manager, Katrineholm works, Pump Separator Co., Stockholm., spoke on living, industrial and labor conditions in Sweden and other European countries. Dan M. Avey, editor, THE FOUNDRY, will be the speaker at the next meeting of the club to be held Dec. 4.

Connecticut Founders Discuss Costs

The regular monthly meeting of the Connecticut Foundrymen's association was held in Bridgeport, Conn., and was attended by about 30 members. Charles A. Klaus, cost expert, Gray Iron institute, described the standard cost system of the institute and told of the advantages to be derived from comparison of costs through the group method. He explained that desirable results may be obtained by comparing such items as manufacturing costs by departments. Such comparisons often bring to light inefficient methods, the speaker said. They also secure figures that make it possible to talk convincingly to shop executives. The speaker then read letters from foundrymen who had been in cost groups for many years, telling of the advantages of cost group work.

A. J. Tuscany, manager, Gray Iron institute, spoke of the plans of the institute with regard to cost work and outlined the other activities of the organization. He also reported on the annual meeting of the institute.

Plan Ceramic Congress

The American Ceramic society will hold its annual ceramic congress at Public Auditorium, Cleveland, Feb. 22-28, 1931. The program will cover art, enamels, glass, heavy clay products, refractories, whitewares and terra cotta.

Canadian Foundry Supplies & Equipment Ltd., Montreal, Que., has moved into its new plant at 4295 Richelieu street. The company formerly was located at 4375 Richelieu street.

CUPOLA PITFALLS and Ways To Avoid Them

Many Important Variables Have a Direct Bearing on the Successful Operation of the Cupola in the Foundry

By Robert W. Watson

ANY attempt to set forth certain fundamental facts in cupola melting should not overlook the lesson taught by experience that it is the exception to general rule that begets progress.

The greatest care is taken when constructing or relining a blast furnace. Long life of a lining is essential for economic success. A great deal depends on a carefully performed blow in and extreme uniformity of operation. Accurate weights are kept of all materials charged. Volume of the blast and its pressure are carefully measured. In fact nothing is left to chance, as happens too often in cupola operation.

A cupola usually is blown in every day. Successful melting depends as much on the lighting, burning of the bed, measurement of air, pressure of the air and accurate weights and measures as does the larger blast furnace.

Opinions Differ

Opinions differ regarding height of the bed, tuyere area, height of the cupola from the tapping hole to the charge doors, materials used and their preparation, placing the charges in the cupola and the amount of air necessary.

It does not seem possible or reasonable to state that a given sized cupola must have a definite height of bed. The several variables of time, volume and velocity of the blast, the burning rate of the coke, the kind of castings to be made and their carbon content all require individual consideration for each cupola. Operating a 72-inch inside diameter cupola, where the metal was required for automobile castings, I secured the best results from a 44-inch bed with 8 to 1 ratio between the charges. The metal charge was 20 per cent steel and we endeavored to carry a uniform total carbon of 3.30 per cent.

Satisfactory operation of a 60-inch inside diameter cupola, melting iron used in casting air cooled cylinders, called for a 35-inch bed with a 10 to 1 ratio between the charges. A third experience had to do with a 30-inch cupola melting iron for small piston rings. In this case it was necessary to carry a 50-inch bed with a 6 to 1 ratio between the charges.

INTEREST shown in the cupola operation course at recent conventions of the American Foundrymen's association indicates that a great number of gray iron foundrymen are anxious to add to their knowledge on this subject. Certain fundamental features in cupola melting are presented in the accompanying article by Robert H. Watson, metallurgist for the Semet-Solvay Co. He writes from an experience of more than 35 years connected with every phase in the manufacture of pig iron, the conversion of iron into steel and the melting of iron and steel in the cupola. His duties have called him to all parts of the country and have involved the handling of all kinds of problems, every size and type of melting equipment in the effort to find successful operating methods.

In each case an accurate measurement was made of the volume of air blown, its velocity and the penetration of the blast. There is a definite relation between volume of the blast and amount of coke used. The entire operation is based upon the proper adjustment of this relation. Every cupola operator should know how much wind he is blowing every minute during the heat, and what the pressure is at all times. With the volume blown comes the knowledge of the amount of coke necessary to use with the penetration and whether this coke is being burned to secure the best possible temperature. Approximately 120 cubic feet of air are needed to burn one pound of carbon so that an analysis of the resulting gas will show approximately 14-15 per cent CO_2 and 9-10 per cent CO. By measuring the blower in use, the proper volume of air necessary easily can be computed.

Determines Dimensions

With a given volume of air the dimensions of the tuyeres may be determined by the penetration of the blast. A simple device may be employed to determine the difference between the pressure in the wind box and the pressure at the center of the cupola. A bar is driven through one of the tuyere peep holes to the exact center of the cupola. This bar is withdrawn and a pipe of the same size inserted. To this pipe a pressure gage is attached. A quick reading is made. The pipe is withdrawn and a reading taken with the same gage of the pressure in the wind box. This difference in pressure offers a means to determine the size of the tuyeres. The best results are obtained when the internal pressure is 20 per cent less than that in the wind box. Method of charging and the kind of material charged will influence the result obtained. Nevertheless, the knowledge obtained by the procedure described permits correcting the charging.

That the amount of moisture contained in the blast strongly influences the temperature of the metal and that

it has a direct bearing on the physical and chemical structure generally is admitted. Experience with the Gayly dry blast, in blast furnace practice, proved this conclusively. Foundrymen are familiar with the action of a cupola on a rainy day when the moisture is precipitated from the air. A well known piston ring company recently installed a refrigerating system for drying the blast. The metallurgist of that plant informed me that the improved quality of the product since the installation, justified the expenditure.

Recent development of the hot blast is another great step in advance. It saves coke, but its greatest benefit will be in securing iron of a high uniform temperature. James MacKenzie, at the plant of the American Cast Iron Pipe Co., Birmingham, Ala., has obtained an excellent hot blast by placing pipes in the lining of the cupolas and heating the blast by the heat derived from the combustion of the coke.

Burning Changes Results

The manner in which the bed is burned marks the difference between a good heat and a poor heat. Where wood is used, dry wood of sufficient quantity to ignite the coke should be used and care should be taken that all this wood is consumed before the blast is put on. Where a torch is used, channels should be laid to distribute the flame evenly. I believe in building the bed up gradually rather than putting in one half or one third of the bed and then topping off. No great benefit has been observed from the so-called soaking of the charge. The heat is obtained in a cupola by burning coke and I do not believe that the best combustion takes place by natural draft. Therefore, as soon as the cupola is charged, the operator should put on the blast.

The material charged into a cupola should be of known analysis, especially in these days of alloys in iron and steel. Frequently scrap containing different alloys is unknown or uncontrolled quantities are placed in the charges, with dire results to the castings made. Where the alloys form a part of the pig iron charged, better controlled results are possible. For the addition of manganese to low manganese mixtures where this can not be obtained from pig iron, it should be added to the charge in the form of spiegeleisen. Where ladle additions are made it always should be remembered that the temperature of the iron to be treated must be high enough to absorb the alloy when it is added.

Metal charges always should be thrown to the outside. If possible an uncovered portion of the coke should show in the middle. Whether steel should be charged first depends on the size and kind of steel. Rails, bars and heavy steel should be charged first, then pig iron, and then scrap. Where light steel is used I believe in throwing it on top of the charges, otherwise it will melt first and run ahead of the charge.

A heavy bed charge of iron is not recommended, as it simply cuts down the coke bed. A uniform weight of charge throughout the entire heat is best. The sizing of material used is most important in securing uniformity of mixture and temperature. The charging of whole cylinder blocks of large size, and chunks of scrap weighing 400 or 500 pounds always is to be avoided. The effort and expense in breaking these up is more than repaid in the uniform temperature and the mixture of the resulting iron.

Mechanical charging eventually will come into universal use. It will save labor costs and insure more uniform iron. Sand cast or machine cast iron is equally desirable, but in machine casting undoubtedly the best results are obtained where an entire heat is poured from one large ladle. Where sand cast iron is used, a sufficient number of samples should be taken for analysis so that uniformity is observed throughout the entire casting of the heat.

The only flux I use is limestone. Fluorspar is used only as a corrective. Best results are obtained by throwing the stone against the lining.

Pick Best Coke

Coke is the essential ingredient in good cupola practice and should be selected more for its physical qualities and its rate of burning than for chemical analysis. Large coke is not necessary to successful melting, but coke of uniform size, free from cross fracture and strong enough to stand the handling and charging and one that when burning will give a high temperature, is the coke most to be desired. I do not believe that an open coke means quick burning nor a dense coke slow burning. The porosity of a coke has little to do with the rate of burning. In my opinion the coal from which the coke is made and the rate and conditions of coking, determines that quality.

All cupolas where I have had occasion to work, had their height established and their equipment bought and running. It is small help to a man in trouble to advise him to raise his charging floor 4 or 5 feet or to buy a new blower. I find that the most economically operated cupolas of 72-inch inside diameter are those not less than 20 feet in height from the iron notch to charging door. Cupolas of 40 to 60-inch work best with 18 feet of height. I find many cupolas much lower, but these use more coke to secure the same results. The best results are not secured by bleeding air to reduce the melting speed. Better results are obtained by melting at a constant rate of speed and with the amount of air and amount of coke definitely set for this purpose.

New England Founders Hear Manager

The regular monthly meeting of the New England Foundrymen's association, was held Nov. 13, at the Biltmore hotel, Providence, R. I. Arthur J. Tuscany, manager, Gray Iron institute, Cleveland, was the speaker of the evening and addressed the meeting on "Progress in the Gray Iron Industry."

In his talk, Mr. Tuscany said that 60 per cent of the factors controlling the average business are in the hands of others and that the trade association movement owed its development to that fact. He then traced the evolution of the trade association from early times through the merchant and craft guilds of medieval Europe to the present.

Years ago, America's production facilities were insufficient to meet demands while at present the reverse is true, according to the speaker. Development of production methods and increased efficiency were thought to be the answer to the problem of increased capacity. Now it is necessary to base prices on less than capacity operation if the gray iron industry is to prosper. Competitive ideas also have changed. Competition now is not as much between individual companies as between industries.

The speaker then pointed out the value of co-operation and pointed to the automobile industry as an example of the benefits that may be derived from it. He outlined the development of the Gray Iron institute and told of its activities in the development of a standard cost system, its solution of merchandising problems, and its efforts toward publicity.

He told of the standard sales agreement and trade customs that have been developed by the institute and outlined other merchandising activities. Research work and other functions of the institute, which include the services of a foundry metallurgist and engineer, dissemination of trade information, organization of chapters in various gray iron centers, the counteraction of unfavorable publicity, etc., were described.

In closing Mr. Tuscany said that industrial leaders were of the opinion that the country was on the threshold of a period of unusual prosperity and that those who were not in a position to take advantage of the situation would lose.

Rensselaer Polytechnic institute, Troy, N. Y., has published a bulletin giving the results of two investigations on the nickel-iron-copper system, by P. E. Kosting and on the nickel-iron-chromium system, by W. A. Dean.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Sand Washes from Gates

QUESTION

We are at a loss to understand why the iron burns the sand on the drag side and sometimes on the cope side of small plate castings for a distance in front of the gates. The iron seems to burn the sand away and then washes it along to another part of the mold where it remains to form a defective area in the casting. The peculiar feature of this problem is that the burning is not consistent. Occasionally we have a perfect heat with all clean castings, then for 4 or 5 days in succession, the trouble appears again. The castings also appear to be strained as if subjected to more than usual pressure. On the theory that hot iron was the cause, we tried cooling it in the ladle, but the only result was that the thinner castings did not run. We have tried several varieties of sand from the Albany district, from Louisville, a regular pipe shop sand from this district, another from a second section of this state and a local sand. All these sands are highly recommended and we have worked them as dry as possible. We have tried different systems of gating and have used sea coal facing in an effort to secure clean, smooth surfaces on these castings, but without avail. We shall appreciate your opinion on what course to pursue.

ANSWER

A scabby, washed or burned area in front of the gates may be due to one or a combination of several causes and it is impossible to lay down a dogmatic opinion without further data or without a personal examination of the molds. Under the circumstances, all we can do is point out the various causes which may be responsible. You can draw your own conclusions and apply the proper remedies. Sand that is too dry or that carries a minimum amount of bond, will wash in front of a stream of iron. This may be the trouble in your case where the sand is carried from in front of the gates and washed to a point further along in the mold. Sand that is too wet or that is rammed too hard will produce a boiling action in the iron and this action in turn will work some of the sand from the face of the mold. Sand that under normal conditions might be rammed fairly hard without causing trouble, will cause the iron to boil and cut the surface, if the steam and gas cannot escape freely. Scabby molds frequently may be traced to tight fitting bottom boards.

The various sands you mention are used satisfactorily in a great many foundries, therefore your trouble must be due either in the manipulation of the sand or by additions of your local sand. If this local sand contains an excessive amount of bonding material and if the silica content is correspondingly low, its presence in any mixture will reduce the refractoriness. From the evidence submitted, we are inclined to the opinion that you are working a weak sand too dry and that it is washing from in front of the gates. You may be able to improve it by the addition of some bonding agent in the facing that goes next the pattern, clay, flour, or any of the dextrine base core binders, but in the event you add any of these materials, you probably also will have to add sharp sand to increase the permeability, and refractoriness. It may be advisable for you to send a sample of your sand to one of the foundry consultants listed in the advertising pages of THE FOUNDRY. From his report you can decide whether the sand or your methods are responsible for the present condition of the castings.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Pattern Plates Used

QUESTION

In some jobbing production foundries I understand they match a considerable number of small patterns on one plate for use in a large flask. They have two plates in the pattern shop, one for the cope and one for the drag, with a number of holes drilled in them. Corresponding plates are used in the foundry. When patterns are received from outside they are matched in the pattern shop and located on the plate by a malleable iron dowel plate 1½ inches diameter, with a ⅜-inch diameter pin 1-inch in length. I have examined several patterns and I do not find any center lines or any holes drilled through them to show how they have been located on the pattern plate. Can you throw any light on this method of mounting patterns?

ANSWER

In the method to which you refer the two plates in the pattern shop and the two plates in the foundry have been drilled accurately on a jig. Pin holes have been spaced

right and left from a center line or lines to insure coincidence between the mold cavities in the cope and drag. With this preliminary work done, the actual mounting of the patterns becomes relatively simple. The malleable iron pins are placed in the holes in one of the plates in the pattern shop. For convenience, each hole bears a number and a duplicate number is stamped near the corresponding hole in the second plate. The various patterns are laid out on the plate to the best advantage and then pressed down. The sharp prongs on the pin plates enter the wood and as a result the malleable iron pin comes away with the half pattern. It then is screwed firmly in place and the pattern is returned to the plate.

Each pattern is treated in a similar manner. Pins then are placed in the corresponding holes in the second plate and the remaining halves of the patterns are placed over them in approximately the proper position. Several methods are available for setting them accurately. One is by measurement with rule and dividers. Another is by making a transfer frame from thin strips of wood. This frame is located by the flask pins on the first plate. Then the inside is built up to touch the patterns at as many points as may be considered necessary. It is removed, turned over either on a longitudinal or transverse axis, depending on whether the cope is simply to be rolled, or, rolled and turned end for end. The reverse transfer plate is laid on the second plate and the patterns are assembled inside it. The pins then are fastened in place as in the first instance. For detailed description covering practically every method for mounting patterns, consult back numbers of THE FOUNDRY, Feb. 1 to May 1, 1922, June 1, June 15 and July 1, 1926.

Q & A

Melt Cans for Weights

QUESTION

We have tried to make sash weights from a mixture composed of 500 pounds of auto steel scrap, 300 pounds of malleable iron scrap and 200 pounds of tin cans. This metal boils in the ladles and molds and castings are honeycombed. Finally we discontinued the tin cans in favor of 200 pounds of stove plate scrap and have had no further trouble. However, we still have about 50 tons of this tin can scrap on hand and will appreciate your advice on how to utilize it.

ANSWER

Several methods are available for disposing of the tin can scrap. Probably the best course, if the freight rate is not prohibitive, is to sell the cans to a company which operates a detinning plant. If conditions are such that you are obliged to use this scrap, you can do so by substituting it in part or in whole for the auto scrap. In your first mixture you had 70 per cent steel and 30 per cent malleable iron, a combination that will not lie still in the molten state. It has to be *killed* and this was accomplished by the substitution of cast iron scrap for the steel scrap in the cans. The cast iron scrap furnished sufficient silicon to the mixture to allay the commotion. Continue using the cast iron scrap and displace 100 pounds of the auto scrap with the tin cans. Increase the dose gradually from day to day until you note the sparks beginning to fly again.

Q & A

Sand Is Cause of Holes

QUESTION

I am forwarding for your inspection a piece of a small flange casting made from white iron melted in an air furnace where pulverized coal is employed for fuel. The casting is molded on a squeezer in green sand and all the openings, including the bolt holes are formed by the pattern. Pin holes, some smaller and some larger than those showing in the piece sent for examination, appear anywhere and everywhere over the surface. I am at a loss to account for this form of defect and will appreciate your opinion.

ANSWER

Lacking a complete knowledge of all the factors surrounding the production of this casting and basing our opinion solely on the particulars supplied and the appearance of the small fragment containing two small pin holes we are inclined to the opinion that the trouble is due to the character of the sand employed in making the mold. It contains small particles of some foreign material. Each particle near the surface ignites under the heat of the molten iron and throws up a small jet of flame or gas which leaves a small worm hole in the casting. If you have changed your source of sand supply recently, or if you have made any radical changes in the method of preparing your sand, this undoubtedly is the cause of the present trouble. An analysis of the sand in your own laboratory, or in the laboratory of a chemist and foundry advisor located in your city, will reveal the probable disturbing agent.

GRAY IRON

Inserts Cause Blows

QUESTION

I am making a small tee casting which has a 1¼-inch pipe cast in it at right angles. The ends of the pipe are filled with sand to keep the metal out and the molten metal is flowed through the cavity, but the castings are defective. How can I get good castings?

ANSWER

You do not state exactly what difficulty you are having, but it probably is blown castings. This may be due to not having the pipe insert perfectly clean or to leaving the pipe set in the mold some time before pouring. To obtain perfect castings where inserts are used, precautions must be taken to have exposed surface of inserts absolutely clean. They must not remain in the mold cavity long enough to condense moisture from the sand.

Consequently, the first step is to clean the insert thoroughly by sand-blasting or other means. Remove all dirt or scale from the surface. Then coat it with silicate of soda, shellac, oil, etc. and dry thoroughly. The coating will assist in preventing rusting. Inserts should be quite warm to the touch when placed in the mold, and should be placed *just* before the mold is closed and poured. A cold insert placed in a warm, damp mold will condense moisture rapidly from the mold atmosphere, and cause blows.

Q & A

Pipes Are Too Thin

QUESTION

Can you tell us if any foundry makes cast iron pipe ¾ to 1-inch outside diameter with a wall thickness of No. 16 or No. 18 Birmingham wire gage and up to 4½ feet in length.

ANSWER

Up to the present, so far as we know, no foundryman has attempted to make cast iron pipe ¾ to 1-inch outside diameter, a wall thickness of No. 16 to No. 18 Birmingham wire gage (0.05 to 0.06-inch) and in lengths up to 4½ feet. In our opinion, cast iron pipe to meet these specifications is outside the range of practical accomplishment. The smallest diameter cast iron pipe now made is soil pipe 2 inches inside cast in sand molds. The smallest diameter pipe cast centrifugally is 4 inches inside.

Q & A

Mixture Is All Steel

QUESTION

Can you give me any information on high test gray iron produced in the cupola using 20 per cent silvery pig iron (10 per cent silicon) and 80 per cent steel scrap? Will I have to add any alloys such as manganese, silicon or phosphorus to the mixture? What analysis should be used for castings ranging from 1 to 2 inches thick and weighing from 600 to 2100 pounds? Will combination of silvery iron and steel scrap be satisfactory for light castings from ½ to ¾-inch thick?

ANSWER

While the 20 per cent silvery pig iron, 80 per cent steel scrap mixture, you mention could be and probably is being used to produce a high test gray iron, you probably could obtain much lower total carbons by using 50 per cent ferrosilicon instead of

the silvery pig iron. R. S. MacPherran states that 3000-pound charges in a 54-inch cupola, composed of 95 per cent steel scrap, 4½ per cent ferrosilicon (50 per cent grade) and ½ per cent ferromanganese showed a general average tensile strength of 58,300 pounds per square inch. The total carbon of the mixture ranged from 2.40 to 3.10 per cent; silicon from 1.60 to 2.60 per cent, manganese from 0.70 to 0.90 per cent. About 1 per cent nickel was added either in the cupola or in the ladle, and about 6 pounds per ton of a ferromanganese-silicon alloy containing 50 per cent silicon and 25 per cent manganese was added at the spout. Coke between charges was from 375 to 400 pounds.

The percentage of silicon in the resulting iron is varied by changing the amount of ferrosilicon added provided the amount of ferromanganese-silicon alloy is not changed. Decrease in the amount of ferrosilicon lowers the silicon and vice-versa. The metal must be handled quickly because it has a shorter freezing range. Gates and risers should be made larger than in the case of ordinary iron. A mixing ladle preferably large enough to contain at least one charge of molten metal should be used at the spout. This will enable you to obtain a more uniform composition in the metal poured.

With the combination mentioned, you will have to do a little experimenting to obtain the best compositions for the various types of castings you mention. Naturally, you cannot expect to obtain the same results from identical compositions poured into heavy and light castings. If the mixture suggested gives good results in the heavier castings, undoubtedly you will have to increase the silicon in metal for the lighter castings, etc.

Q & A

Coating Makes Holes

QUESTION

I am experiencing some trouble with chilled lathe beds from blows on the chills which give the metal a honey-comb appearance on the gate end. Examination of the chills and casting seems to show that the difficulty arises from the wash used on the chills. The chills are washed with a solution of 1 part of molasses and 8 parts of water thickened to the consistency of ordinary varnish with plumbago. The surface then is heated as much as possible with a drying torch.

ANSWER

The main points to observe in using chills against which molten metal is poured is to see that the chills are perfectly clean and dry, and that they are not allowed to stand in the mold and condense moisture from the sand. Therefore, your difficulty may arise from either of these causes. Sandblast chills to give clean surface, and then if you wish, give them a thin coat of shellac, water glass, blacking, or plumbago wash, etc. The chills should be dried thoroughly after coating. The only value of the coating is to prevent rusting. If possible the chills should be placed in the molds while still warm, and the mold poured as soon as possible thereafter.

If the chills are large and heavy, it may be inconvenient to dry them in an oven after coating. In such cases it probably will be better not to coat them with any aqueous solutions. Place them in the mold after being sure that they are perfectly clean, and just before the mold is closed and poured, heat them with an oil torch to dry off any moisture that may have condensed. As previously stated, if the chills are clean and dry, no trouble will be encountered from blows.

Q & A

Allow Finish on Roll

QUESTION

What amount of finishing allowance is necesasry on a chilled roll 10 inches diameter and 4½ feet in length. The patternmaker suggests 1/16-inch, but I do not think 1/32-inch to a side is enough.

ANSWER

If your patternmaker meant a total of only 1/16-inch in diameter, that is as you interpret it only 1/32-inch of metal to be removed, he is over confident. Rolls cast in the same chill on succeeding days will show that much variation in the rough state. Many factors must be taken into consideration, factors that effect the contraction, in casting chilled rolls and for that reason ⅛-inch finish is about the least you can allow on a 10-inch diameter roll. Under normal conditions this roll will contract 3/16-inch in diameter. Adding at least another ¼-inch for finish, means that the inside diameter of the chill must be 10 7/16 inches.

Q & A

Silicon Is Low

QUESTION

We are sending you a sample casting with which we have had considerable trouble. The face and grooves which are formed in a cover core as you will notice are machined, but the edges are so chilled that it is difficult. The heat is made up of 60 per cent pig iron; 30 per cent scrap, and 10 per cent steel which gives an analysis of: 2.00 per cent silicon; 0.080 per cent sulphur; 0.54 per cent manganese; 0.202 per cent phosphorus, and 3.47 per cent total carbon. The cores are made from 60 parts of silica sand and 40 parts of fine molding sand bonded with pure linseed oil in the ratio of 70 sand to 1 oil.

ANSWER

The average thickness of the casting you submitted for examination is about 3/16-inch, and we believe that you can overcome the tendency of chilled edges by increasing the silicon. We suggest that you raise the silicon to 2.25 per cent. If that does not prevent the chilling, increase it a little more. It may be possible that the core has something to do with the chilling tendency. At least it is the cause of the small holes just under the edges of the casting. We believe that the fine molding sand may be eliminated altogether. Make your cores with sharp sand and oil. The sand should be coarse enough to carry away the gases, but not too coarse. If the sand is too fine, the gases are not carried off, but kick back into the congealing metal.

Q & A

Rough Surface Required

QUESTION

We are interested in the use of an abrasive such as silicon carbide or aluminum oxide for the surfacing of cast iron stair treads, etc. From information we have obtained, we understand that aluminum oxide grains are more suitable as the grain fiber is not as long as that of silicon carbide. We have tried the oxide grain on the surface of a green sand mold, printing back to prevent the grains from floating around in the molten iron. Have you any data on the use of this grain in surfacing cast iron?

ANSWER

Silicon carbide is used to give a rough surface to castings such as you mention, but we do not have any data on the use of aluminum oxide abrasive. However, we believe it could be applied similarly to silicon carbide. The method used in applying the silicon carbide, and which is claimed to be proprietary, is to make the mold in green sand. See that the mold which contains the surface to be treated is on a smooth bottom board. Spray the face of the mold with a solution of 1 part of silicate of soda (water glass) in 6 parts of water. Sprinkle the face of the mold with carbide of silicon grains so that a uniform coat is applied. Then print back the pattern so that the grains are pressed into the sand and present a level surface. With a thick casting use large silicon carbide grains and finer crystals with the thinner castings. Remove the pattern and spray the mold face with sodium silicate lightly. Dry the surface with an oil torch. Allow the mold to cool and sprinkle the surface with powdered fluorspar.

The silicate and fluorspar form a flux which causes a partial fusion of the carbide and causes it to adhere to the iron. The mold is gated so that the metal will run over the full length of the face of the mold to an overflow head. The iron must be as hot as possible to cause the required fusion.

Problems in Nonferrous Founding

By Charles Vickers

Melting May Be Cause

We find porosity in castings made from 85-5-5-5 *remelt ingot purchased from a leading manufacturer. The metal is melted in oil-fired pit furnaces with a heavy layer of bottle glass and charcoal for protection against gases and we place* 2 *ounces of* 15 *per cent phosphor-copper for each* 100 *pounds of metal in the bottom of the crucible before charging. In addition we try and keep the flame a brilliant white. In spite of these precautions we find porosity in a number of our castings, being more pronounced in heavy sections. We are sending you a sample cut from a casting to illustrate the condition. This casting was a ring* 3 *feet diameter, gated on the sides. This condition appears in heats consisting of all ingot, all scrap, or half ingot and half scrap (gates). When the ingots are cut in half they appear sound. Is this porosity caused by oxygen, excessive phosphorus, steam from the mold, or sulphur and carbon gases from the fuel oil? Gates sometimes lie on the layer of molten glass for several minutes before sinking through to the bath of metal beneath. We have been informed by several brass founders that an excess of air in melting will insure sound metal although increasing the metal loss. The sand used for all castings is No.* 1 *and No.* 00 *Albany acording to the weight.*

First discover whether or not the ingot metal is at fault, because there appears to be doubt in regard to that point. If the ingot metal is not used for a couple of heats, but the results are the same as with the ingot, that centers the blame on the melting or other operations carried on in the foundry. You mention a heavy layer of bottle glass on the molten metal. That is bad practice unless the crucibles stay in the fire some 3 hours to melt 300 pounds, then it is needed. A fast melting furnace does not need any bottle glass to keep in the absorbed gas, for by the time the gas is driven out the metal is ready and is poured. It has no time to absorb gas. Experience with fast melting furnaces has shown that a heavy cover gives porous castings. Use a handful of borax instead.

A brilliant white flame is rather overdoing it. Let the flame incline to whiteness. It must not smoke, neither should it be too brilliantly white, so cut the air a trifle. This is all on the side of prevention. An excess of air will not insure sound castings. In pouring off a certain type of furnace for instance, it frequently happens that the first ladle gives sound castings and subsequent ladles give varying degrees of porosity, due to the fact that the furnace is skimmed before being poured into the ladle. The first ladle is filled with metal that was given no time to absorb the hot gases of the furnace atmosphere, but not so with the second, and it is worse with the third. Briquetted charcoal thrown onto the surface after taking away the first ladle saved the day. Also turning the furnace mouth upwards is helpful, as the gases rise off the metal. Use only a thin layer of flux; ⅛-inch is enough, and if a No. 70 pot is pulled in, say 35 minutes, use no flux other than a little borax, charged when the pot is cold.

Q & A

Core Causes Gas Holes

We are having trouble with bushings due to gas spots on the inside which are found when the bushings are bored out. These holes are clustered on a portion of the inner diameter and are not distributed uniformly. The castings are molded horizontally, a runner is laid alongside the pattern and from this three gates are taken off at equal intervals, from runner to bushing. The metal consists of 85 *per cent copper;* 6 *per cent lead;* 6 *per cent zinc, and* 4 *per cent tin, and we pour it at* 2000 *degrees Fahr. We use oil sand cores made of* 15 *parts sharp sand;* 1 *part molding sand and* 1 *part oil, using the raw linseed oil. The cores are blackened with plumbago, rubbed on by hand, the molds are vented and floured and an open grade of sand is used. We do not appear to have any trouble with the outside of the castings; it is the inside that is filled with gas pockets. The metal is melted in coke-fired crucibles and charcoal is used on the top of the metal.*

Frequently the greatest troubles of the brass founders life center around these epidemics of localized porosity. A casting will come good all the time except in one place, which may be little or big acording to the size of the casting. In this one spot, after the skin of the casting is removed, pores are revealed, in size ranging from a pins head to a pea. Evidently it is not a metal defect; all other castings made from the same heat come good, and the defective casting is good in all places, except this one.

Every effort should be made to get at the root of the trouble so that it can be avoided in future, and the best way of doing this is to start a process of elimination; that is make changes on every mold, eliminating one possible cause after the other until the right one is found, for there is most certainly a cause somewhere. This has to be done because the causes underlying such troubles are not always the same in every case. With this bushing, we suggest starting on the core by making an entirely different core. Make the core in halves and paste it together, if this has not been done in the case of the old cores. Try various types of binders for bonding these test cores. Also have the core well vented, and see the metal is kept out of the vent. Pour a couple castings in this way and note results.

The core is stronger than necessary. It is 16 to 1, whereas a rich mixture using oil is 32 to 1, and sometimes as little as one part oil to 100 parts of sand is used successfully. The porosity is caused either by the mold or the core, with the latter subjected to most of the suspicion.

Q & A

Facing Sand Is Fine

What is the best sand for making matchplates?

Since aluminum is an extremely light metal, the sand used in the molds will have to be an open grade to prevent any fluttering or boiling due to the gases being unable to escape freely. However, since you also will desire as smooth a surface as it is possible to obtain, we suggest that you face the mold with a fine sand such as No. 00 Albany or Windsor Locks. One expert with experience in casting matchplates uses all No. 00 Albany sand, but as this sand is fine, it requires careful handling to get the best results. Our suggestion would be use a fine facing as suggested with a good open sand for the backing. This will give the desired smooth face to the casting, and the open backing sand will allow excellent venting qualities.

The FOUNDRY Family Photograph Album

©Blank & Stoller

Upper Left

J. D. STODDARD
Detroit Testing Laboratory, Detroit

Upper Right

R. E. BRYANT
Jefferson Union Co. Inc., Lockport, N.Y.

Lower Left

G. H. WEBB
Troy Engine & Machine Co., Troy, Pa.

Lower Right

H. S. FALK
Falk Corp., Milwaukee

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NONFERROUS MATERIALS OF CONSTRUCTION

In Aircraft Engines

(*Continued from Data Sheet No.* 838)

However, the modulus of elasticity of the forged and heat-treated alloy *L* and the cast alloy *C* are practically the same. This means that under the same stresses below the elastic limit the deformation is practically the same in each case. For this reason any gain in weight obtained by decreasing the wall thickness of the forged crankcase is done at the expense of stiffness. The forged crankcase, however, has the advantage of a higher yield point which means that higher stresses can be endured without assuming permanent set as might occur in the case of occasional over stress.

Furthermore, the forging has greater ductility which will permit more distortion before cracks and ruptures are started. Unless forgings are used in a great quantity they are not cheaper than castings because of the high die costs which add considerably to the price of each forging when only a few are made. A disadvantage of the forged crankcase is the limitations of the designer to place bosses, passage ways, grooves, etc., integral with the casting. A crankcase must be designed specifically for a forging or for a casting. One type of manufacture cannot be converted to the other without radical changes in design.

Use of Magnesium Alloys Developing

Rear crankcase sections of radial engines have also been made from the magnesium-base alloy *I* which is considerably lighter than any of the aluminum alloys and has excellent physical properties. Due to the difficulty of handling magnesium in the foundry and the susceptibility of this alloy to corrosion, magnesium alloys have not developed rapidly until recently. Improved methods of handling have been devised which greatly facilitate the casting of magnesium.

Susceptibility of magnesium alloys to corrosion has been reduced greatly by the use of magnesium of higher purity and the addition of special elements to the alloy. In designing parts to be made from magnesium alloys it should be remembered that the modulus of elasticity is only about 6,250,000 pounds per square inch as compared to a value of 10,250,000 pounds per square inch for the aluminum alloys. This means that the magnesium alloy is subjected to greater deformation under load. Experimentally, various other parts such as crankcase sections, supercharger housings, oil pump sumps have been made of magnesium alloys.

Cylinder heads on air-cooled engines are made of aluminum-alloy castings on all large engines and have been made from cast iron on a few small engines below 100 horsepower. Aluminum alloys are used for heads, not only to reduce

(*Continued on Data Sheet No.* 840)

NONFERROUS MATERIALS OF CONSTRUCTION

In Aircraft Engines

(*Continued from Data Sheet No.* 839)

the dead weight of the engine but also to provide sufficient cooling for the combustion chamber. The thermal conductivity of aluminum alloys is about three times that of cast iron. This high thermal conductivity makes aluminum heads less subject to hot spots, local weakness and cracks. The two alloys most used are alloys *E* and *F*. The primary reason for their use is that they have a greater strength at high temperature than most other aluminum alloys. One British manufacturer makes the head from alloy *E* forged. This requires much difficult and expensive machining and would not be welcomed by American manufacturers.

Pistons are made from alloys *E*, *F* and *A* in sand castings and from alloy *K* in permanent-mold castings. The light alloys are used for pistons, not only to decrease the dead weight but also to decrease the inertia forces of the reciprocating pistons. As in the case of cylinder heads, the advantages of high thermal conductivity of aluminum alloys are less susceptibility to hot spots, local weakness and cracks. One disadvantage of the aluminum alloys for pistons is their high coefficient of expansion which requires greater clearances between the piston and the cylinder wall. The alloy *K* which is high in silicon has certain advantages over alloys *E*, *F* and *A* in that it is lighter and has a lower coefficient of expansion than these alloys. A decided disadvantage of this alloy is that it is extremely difficult to machine.

Silicon Reduces Shrinkage

Intake manifolds and other thin-walled castings offer some casting difficulties and are usually made from alloy *G* or *H* to eliminate foundry losses due to misruns. These silicon alloys show a low shrinkage which facilitates the productioin of complicated castings. They have good tensile strength and elongation and are dense and pressure tight, but show a low yield point and are somewhat difficult to machine.

When such parts as covers or lids are used in multiple on engines, so that they run to large quantities, die castings are desirable. The practical advantage of die castings is that they can be finished closely to dimensions and produce castings with smooth surfaces; practically no machining is required; holes can be placed with great accuracy. There is no doubt that die castings will find an increasingly large application for unstressed parts of aircraft engines. Apparently a wide field for this type of casting is in aircraft accessories such as the carburetor, certain types of which have become more or less standard on several types of engines.

(*Continued on Data Sheet No.* 841)

THE FOUNDRY DATA SHEET, DEC. 1, 1930
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Bill Goes on a Trip Among the Gates

By Pat Dwyer

THE English language," Bill remarked the other night, "is sure a wonderful and fearful institution. When you consider that a single word may have from one to 57 different meanings, it is a constant source of wonder to me how we manage to understand each other."

"We don't," I said.

"Don't what?"

"Don't understand each other. I have been speaking what I have been led to believe is the English language ever since I can remember and up to the present I have had no difficulty in taking a person's meaning, provided," I remarked significantly "provided the party of the second part, talks sense. What's the idea of dragging mixed pickles into a language discussion?"

"I guess you're right," Bill said. "Not much use trying to convey an idea to a poor prune who is just naturally dumb, whose mind never rises above the level of pickles, mixed pickles. Mind you I have no objection to snapping up one of these juicy trifles now and again, but there is a time and a place for everything."

"This is neither the time nor the place to snap at me," I pointed out as kindly as possible, "I am not a pickle."

"You would have a grand time trying to prove that in a law court," Bill grinned. "However, that is neither here nor there, as the aviator remarked when he plopped in the middle of the lake. Down at the shop today I had occasion to comment on the way a certain young lad was cutting a gate and he said that he wished once and for all that I would straighten out this here now gate terminology. "He had heard the whole thing referred to as a gate, a runner, a sprue, a pop, a pouring basin, a skimmer. The hole on top of the cope is a gate. The vertical opening is a gate. So is the channel at the joint of the flask. The opening from the channel into the mold cavity is a gate and then to further complicate the situation, the piece of metal that remains in any of these cavities after the metal has solidified, also is a gate. How can the same name apply to a hole in the sand and to a solid piece of metal? This barrage brought to mind an animated discussion of the same subject at one of the shop operation sessions held during the American Foundrymen's association convention here last May. I sat next to a young German foundryman during the discussion and after the meeting he harked back to one of the questions: What is the pouring basin, the sprue, the runner and the gate?

"He said it was not difficult to agree upon a definition for each of the first three items, but he was surprised at the lack of unanimity on the meaning of the word *gate*. He claimed it should be easy to find the definition if we consider the derivation of the word. In the Swedish and Finnish languages the word *gatan* means street, alley, also the entrance or inlet. In German the word *gat* means an opening or hole. It is part of the word Kattegatt, the name of the narrow entrance from the North sea into the Baltic and literally means cat hole. In ordinary English usage the word *gate* also means an opening into a certain space or yard. For these reasons he would say the gate in molding practice means the opening through which the metal enters the mold."

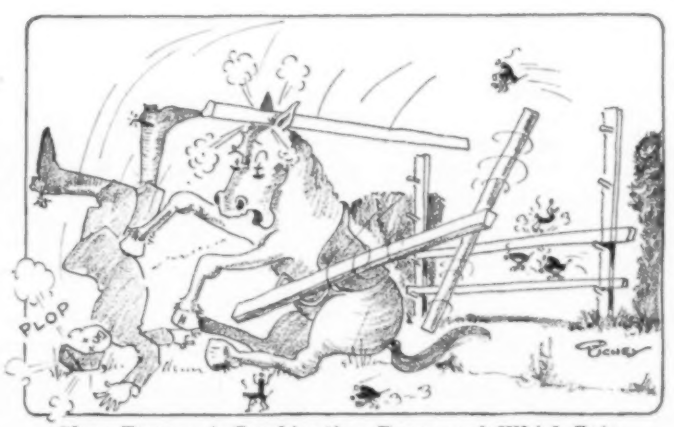
"That seems to be satisfactory enough," I said.

"Satisfactory?" Bill exclaimed, "'Pon my word, sometimes you make me think these lads who believe in the transmigration of souls are not so far wrong. In a former state of existence you must have been a knothole in a board. Everything goes right through you.

"That description of a gate puts us no farther ahead than we were at the beginning. The Swedish *gatan* and the German *gat* mean a hole, but the hole may be a mile in length or only an inch. It may be as straight as a string and it may be as crooked as the Kattegatt, one of the most difficult passages in the world to navigate. If we accept these words for a guide, the entire passage from the top of the cope to the edge of the mold cavity is a gate.

"The English word *gate* is no more reliable guide. Under certain conditions it may mean an opening, but in its wider and more generally accepted meaning the word refers to a device of wood or iron swinging on hinges and designed to close an opening. That, my dear lad, is a horse with an entirely different set of shoes.

"Coming a cropper over a beastly 5-bar gate has knocked the joyous yoicks and tally-ho out of many a portly and red coated fox hunter and left no illusion in his mind as to whether a gate is an opening or a barrier invented by the devil to spoil a day's sport. Presumably the fox may hold a different and more lighthearted opinion on the subject, but as he is neither a voter nor a land owner, his viewpoint, up to the present has not been taken into consideration. If the wily foxes ever become organized, I rather fancy y'know their slogan will be 'More and Higher Gates!' "Perhaps it is there," I admitted, "but I must confess I fail to find any connection between fox hunting, or the mental gymnastics of a fox, and the



Shop Term: A Combination Down and Whirl Gate

meaning of the word gate as applied to molding practice.

"Touching on your recent reference to transmigration of souls and basing my opinion solely on your involved method of presenting a subject, I should say that at no great distance in the past you sported a long, bushy tail, stole hens for a living and started an argument with every fox you met just for the pleasure of hearing yourself bark."

"Well," said Bill, "I'll tell you. On several occasions since the convention, the discussion has come to mind and each time I have wondered why the discrepancy in terms never occurred to me before. In all the years I have spent in the foundry I never heard the point discussed. Every person took the terms for granted and so far as I can remember no one ever was at a loss to understand what was meant when another person referred to a gate. I suppose the context always served as a guide. For example if the old man came along while you were placing a gate stick in the cope and said, 'That gate is too small, or too long,' you did not stage an argument to find if he meant the gate, the runner or the sprue. You knew instinctively that he was talking about the gate stick—and you changed it. If he said, 'Knock that gate off as soon as she is set to keep her from cracking,' you did not ask him if he was referring to the pouring basin, the head, the upright piece of metal, the runner at the joint or the comparatively short branch connected directly to the casting. You hit the thing a belt with a hammer and separated it from the casting.

"According to strict grammatical construction the *she* and the *her* in the first sentence of the preceding paragraph refer to the gate and yet the molder knows instinctively that the old man is worrying about the casting cracking and not the gate."

"Apparently," I said, "a young lad with a knowledge of grammar is at a decided disadvantage in a foundry."

"Oh, well, I wouldn't say that," Bill grudgingly admitted, "The knowledge will not do him any harm, but on the other hand he will not find any use for it in his daily work. However, he does not need to worry. Before he is in the shop a week he has acquired a new and wonderful vocabulary. Youth is adaptable. Words, phrases and sentence construction that would cause his hair to stand on end in the old alma mater days, now slip off his tongue as readily as blacking from a swab.

"So long as he is among his own kind he has no need to split hairs over the fine shading of words. Only when he gets into a discussion with others who have not had the same training, does he realize the necessity of accurate phraseology.

"For example Mr. Horace (Slim) McGonigle and Mr. Michael Augustine (Red) Rooney in their capacity of self-appointed critics, are commenting on the setup of a job on a neighboring floor. Slim remarks cheerfully that the thing will be a waster and Red laconically says 'Sure.'

"'Now, down our way,' Slim continues, 'we always run them things through a whirl gate at the bottom an' a pop at the top for a whistler.'

"Michael Augustine nods sagely and admits that the idea is O. K., but if he had his way he would stick a small branch near the top to kinda freshen 'er up, see what I mean?

Spring Showing of Something New in Rammers

"Thus with the exchange of a few words, each forms an accurate mental picture of the mold, the gating arrangement and their relative position in the flask.

"To convey his idea to a person not familiar with foundry practice, Slim probably would have to draw several sketches and then explain that the molten metal from the ladle enters an opening at the top of the cope, flows down vertically through a continuation of that opening to a point on a level with the bottom of the mold cavity. Here it enters a horizontal passage leading tangentially to the mold. The object of this lower gate construction is to convert the vertical down flow of the metal into a whirling motion as it ascends in the mold. The incidental centrifugal force tends to hold any dross or dirt in the center where it will not impair the appearance or value of the casting. The whirling motion also keeps any dirt floating on the top and either carries it up into the riser or into a position where later it may be cut off.

"The whistler is a small opening leading from the top of the mold cavity to the top of the cope. Metal rising in this opening serves as an indication that the mold is nearly filled with metal. The man manipulating the ladle checks the stream and pours the remainder of the metal slowly for the double purpose of easing the strain to which the mold is subjected and to compensate for the shrinkage that is taking place.

"Red's contribution, a small branch near the top, means a small channel from the upright runner to a point near the top of the mold. The metal rising in the mold loses heat and becomes sluggish. Hot metal entering through the small gate helps to equalize the temperature between the metal at the top and the bottom of the mold and also provides hot metal where it is most needed to feed the casting as the metal shrinks. If a gate simply meant a hole through which the metal might be spilled into a mold, half the foundryman's troubles automatically would disappear. Unfortunately, the size, shape and position of the gate exert such an important influence on the casting, that they merit the most careful attention. In many instances the cause for a defective casting is laid at the door of the sand, the iron, the melting practice, the core, the method of venting, or as they say at a coroner's inquest, to the will of God, when in reality the gate is responsible. Even where a gate meets all the requirements of shape, size and position, its condition at the time the metal is poured through it may be the cause of a defective casting.

"I had an inquiry recently from a lad who wrote that internal shrinkage shows up after boring on a great number of cast iron bushings 2¾ inches inside diameter, 4¾ inches outside diameter and 6 inches in length. The castings are poured on end and the defective area appears at a point between the center and the top as indicated in the accompanying sketch.

"The defect shown on the sketch may be due to one of several causes, or possibly to a combination of two or more. If he had submitted a castings instead of the drawing I should be in a better position to draw conclusions. The defect *may* be due to shrinkage of the metal, but on the other hand it may be due to something else. A suggested remedy for shrinkage would be of no value, if, for example, the defect was due to

foreign inclusions in the metal. Taking them in the order of their relative probability, the factors responsible for the defective castings are: (1) Sand or slag inclusions in the metal (2) boiling iron (3) shrinkage.

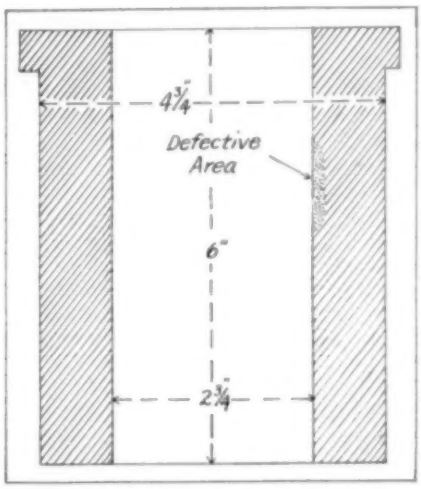
"Unless the runner and gate are perfectly clean, the stream of iron will carry loose sand into the mold. In some instances the runner and gate may appear to be clean, but if the sand is too wet or too dry, the iron will wash some of it away and carry it into the mold. An examination of the solidified metal in the gate and runner will show whether the metal passed through properly, or, carried some sand with it. Where proper precaution is not observed, slag sometimes flows into the mold with the iron.

"Under exceptional circumstances, this foreign material, whether slag or sand, will float to the top of the mold until it comes into contact with the cope. However, usually, it is held in some other part of the mold. This is particularly true in molds with vertical walls. The spongy mass of material floating on the iron touches the cold sand wall and is held there by the film which instantly forms on molten metal in contact with a cold surface. The rising body of iron flows around and over the foreign material which remains hidden until it is exposed by a machine tool. A suggested remedy for this condition is to pour the iron through some form of skimmer gate. Many types are available and no trouble will be experienced in selecting one to meet the particular requirements. The detail of course will depend on the style of flask employed and the number of patterns in a flask. Incidentally, it may not be out of place to point out that a set gate of any kind is preferable to one cut with a gate cutter or any other tool.

"The boiling iron referred to in the second probable cause of the defect, may be caused by wet sand, hard sand, patterns placed too close together in the mold, or by the core. Where the sand is wet or hard the escaping steam enters the metal and causes a commotion. If the iron remained liquid indefinitely, the steam eventually would escape. Unfortunately molten iron solidifies rapidly and the result is that the steam or water vapor remains trapped in the metal. The spongelike formation is due to the manner in which the vapor breaks up in an effort to escape.

"Sand of a density and hardness that ordinarily would work satisfactorily, frequently will cause the iron to boil in mold cavities that are located too close to each other. This applies particularly to deep molds where the sand walls between the molds are comparatively slight and where the sand has to be rammed quite hard to prevent the castings from straining or swelling at the bottom. The remedy in this instance is to use sand with a higher permeability, or vent the sand walls between the castings with a vent wire. A simpler remedy, of course, would be to use a smaller number of patterns for any given flask and space these patterns farther apart. However, that remedy never is adopted except as a last resort, because it interferes with production.

"A hard core, or a core from which the vent does not escape readily, may cause the iron to boil in the vicinity. This point, and others in connection with debatable features, may be settled definitely by pouring a mold unincumbered by a cope. By watching



Floating Slush Lands at the Point Indicated by the Arrow

the action of the iron closely as it rises in the mold, the investigator usually can determine to his own satisfaction what is responsible for a defective casting. On general principles, all bushing cores should be made hollow. They are entirely surrounded by metal, therefore every precaution should be taken for the easy and rapid escape of the gas that is generated during the period the metal remains in the molten state. A bushing core should be formed from a clear, free venting sand, bonded with a minimum amount of binding material and dried thoroughly. The hollow feature facilitates the escape of the gas and also saves a certain amount of sand. On large cores this feature amounts to quite an item. In the present instance, a 2¾-inch core, the vent hole in the center may be 1-inch diameter.

"The evidence submitted does not support the claim that the defective area is caused by shrinkage. However, in the event that shrinkage is a minor contributory factor, it may be overcome by raising the pouring head and increasing the size of the gates and runner. Under certain conditions, pouring the iron slowly will produce the same result."

English Research Group Holds Meeting

The British Cast Iron Research association held its annual meeting at the Victoria hotel, London, on Oct. 29. The annual report which was presented enumerated the various activities of the association. These include investigations of molding sands and refractories, cupola melting practice, malleable cast iron, structure of cast iron, alloy cast irons, and strength of cast iron in relation to size. Research work by the association has led to the development of a heat resisting cast iron with high silicon and containing aluminum with or without chromium, and a new type of cupola. Both of these developments will be licensed for members' use.

Following the presentation of the report Sir H. B. Hartley, London, Midland & Scottish Railway Co., was elected president of the association to succeed Sir P. A. M. Nash, Metropolitan-Vickers Electrical Co. John Craig, David Colville & Sons Ltd.; Sir W. J. Larke, National Federation of Iron and Steel Manufacturers; W. T. MacLellan, Bengal Iron Co. Ltd.; W. Reavell, Reavell & Co. Ltd., and A. W. Steven, Allied Ironfounders Ltd., were re-elected vice presidents.

Members of the council of the association who were re-elected include F. Ayton, Ransomes, Sims & Jeffries Ltd.; S. F. Barclay, Mather & Platt Ltd.; R. P. Bethell, Bradley & Foster Ltd.; E. R. Briggs, English Electric Co. Ltd.; V. C. Faulkner, *Foundry Trade Journal;* Ambrose Firth, Brightside Foundry & Engineering Co. Ltd.; Prof. D. Hanson, Birmingham university; G. Pate, Carron Co.; P. Pritchard, Midland Motor Cylinder Co. Ltd., and F. J. Taylor, Taylor & Son Ltd. Newly elected members of the council included Sir Henry Fowler, London, Midland & Scottish Railway Co., Major Richard Miles, Newton, Chambers & Co. Ltd.; James Smith, Smith & Co. (South Shields) Ltd.; John Ward, Hardie & Gordon, and J. M. Weir, Charles W. Taylor & Son Ltd.

After the annual meeting a luncheon was held in the Victoria hotel which was attended by approximately 130 members and guests including representatives from Australia, India and New Zealand. The new president, Sir Harold B. Hartley, was in the chair, and in addressing the group said that there were over 3000 foundries in Great Britain and that the total value of the castings produced annually is around £200,000,000. Major F. A. Freeth, Imperial Chemical Industries Ltd., and Loughnan St. Pendred, president of the Institution of Mechanical Engineers, replied to the address.

Fundamentals of

FOUNDRY PRACTICE

Different Types of Iron Pouring Ladles Are Used Cold Metal Cause of Blowholes in Iron Castings

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part XXIII

POURING equipment in the gray iron foundry includes ladles for hand pouring and others handled by a crane. Pouring ladles transported by man power include hand ladles holding from 20 to 60 pounds, shown in Fig. 284; pouring ladles with single shank, Fig. 285, holding from 80 to 250 pounds, and pouring ladles with two forks, Fig. 286, holding from 500 to 600 pounds. In American foundries 300 pounds is about the limit for ladles carried by man power. In many foundries all the ladles are transported mechanically.

Typical crane ladles with lifting bail are shown in Figs. 280, 281 and 282. The first is designed to carry from 1000 to 2500 pounds. The second is provided with a gear device for tilting and is made in capacities up to 5 tons. The style of geared tilting ladle shown in Fig. 282 is employed for handling quantities of molten metal above 5 tons.

In the smaller sizes, one piece pouring ladles are the strongest. Single shank hand ladles are not to be recommended. They cause accidents due to the difficulty in walking with them. Some old-time molders, set in their prejudices, claim that it is harder to pour with a double shank ladle. That is a mistake. A few days' observation will convince anyone of the advantages of the double shanked ladle from every viewpoint.

Pouring the Metal

CERTAIN types of ladles are preferable to others for distributing the metal. In every case the lining material must be applied carefully and the ladle must be dried thoroughly and heated before the molten metal is poured into it, either from the cupola or from another ladle. All slag is skimmed from the surface of the metal in the ladle and a thin coating of sand is applied before the stream enters the pouring basin. Special types of gates and runners also assist in preventing impurities from entering the mold. Cold metal is the most prolific cause of blowholes in a casting.

The single shank ladle is almost unknown in American foundries. Many foundries in Europe have adopted the double shank ladles. They are easier to carry and tip, safer and less tiresome to the men handling them. Carrying tongs or scissor shank, an almost obsolete piece of lifting equipment, should not be used. It is risky and may cause a loss of time.

Crane ladles usually are equipped with a mechanical tilting mechanism, an irreversible reduction gearing. This mechanism is not needed on ladles up to approximately 1-ton capacity. Above that weight it is necessary. Modern tilting mechanism consists of machined gears enclosed in a steel case and running on ball bearings in oil.

The pouring drum type of ladle finds favor with some foundrymen through its advantage of holding the metal at a high temperature. It is tilted by hand shanks or by a reduction gearing as shown in Fig. 283.

Foundries without large ladles or powerful hoisting equipment have recourse to stationary pouring basins similar to that shown in Fig. 287. One of these reservoirs may hold from 20 to 40 tons or more and is provided with an opening at the lower part. The interior is heated with a strong coke fire before the first iron from the cupola is poured into it. Additional iron is transferred from the cupola to the reservoir until the required amount is accumulated.

To line a new ladle, smear the inside with clay wash. Then daub the lining material over the surface with the fingers to help make it stick. Usually the same material

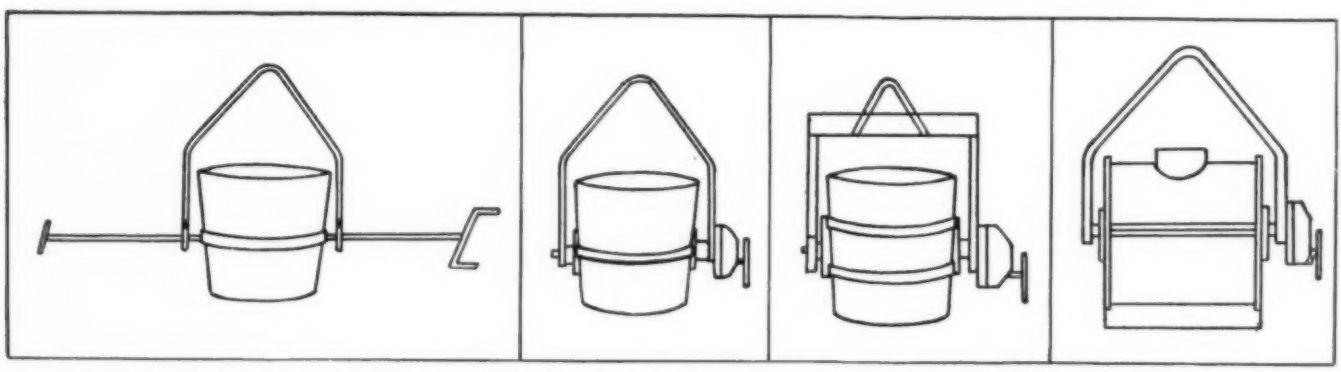


Fig. 280—Crane Ladle Designed To Be Tipped by Hand. Figs. 281 and 282—Small and Large Crane Ladles with Gear Tipping Device. Fig. 283—Drum Type Ladle

employed to daub the cupola is used for daubing the ladles.

Ram new sand or daubing material over the bottom of the ladle. For hand ladles the thickness of this bottom should be ½-inch, and for the large ladles it may be from 1 to 1½ inches. Ladles with capacity of 5 tons or more usually are lined with brick.

The completed lining is coated with clay wash or black wash. Large ladles are dried with a coke fire basket or with a direct wood fire. Small ladles are dried in an oven or up against a fire basket. After the lining has dried all cracks are closed with some of the daubing material.

The drying of the lining should be thorough. This is helped by the air vents drilled or punched in the ladle shell. If the ladle simply were air dried bubbling would start the moment the metal flowed into it. This would loosen up the lining and the metal might burn a hole through the ladle shell.

Remove the Coke

Some founders claim that it is dangerous to leave a coke fire in the ladle when pouring in the iron, as it may add sulphur to the iron. This view seems to be rather far fetched, but if a man wants to avoid contact between the coke and the iron, he always can dump the coke out just before running the metal. A wood fire also can be built in the ladle with pieces of wood too long to put into the cupola. Charcoal frequently is used to cover the molten metal in the ladle and thus keep it hot. If a stationary basin is required to collect the iron a good coke fire will heat the refractory lining properly to keep the metal in a liquid state for several hours. The coke continues to burn later on top of the iron.

Stationary basins and large ladles holding more than 5 tons usually are lined with flat fire bricks. In recent years the oil burner has been employed extensively in drying and heating ladles, both large and small. This precaution helps to keep the metal at a high temperature. Even small castings may be poured without any trouble.

From the cupola the metal is taken to the molds. In light work shops the metal may be taken directly from the spout in small ladles. A line of men passes the spout in succession and each man fills his ladle in passing. The practice is known as *catching in*. This method also is applied where larger ladles are suspended from a monorail.

In large foundries engaged in the production of small castings, the metal is distributed to several ladles located at the various molding stands and holding from 700 to 3000 pounds. In that way quantities of metal can be poured in a short time.

In many American foundries a reservoir ladle with a capacity equal to half of the hourly melting capacity is placed under the cupola spout. This ladle is tilted by a reduction gearing and receives the metal from the cupola at fixed intervals. When it is necessary to fill one of the regular ladles, it is done by a turn of the wheel and there are no long waits for the ladle to fill. Furthermore, the iron is well mixed. The variations in composition are slight and time is saved in pouring.

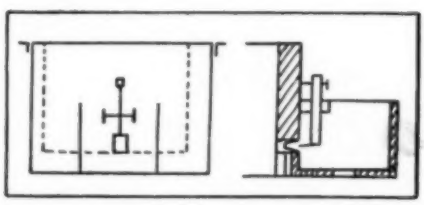


Fig. 287—A Reservoir Sometimes Is Employed

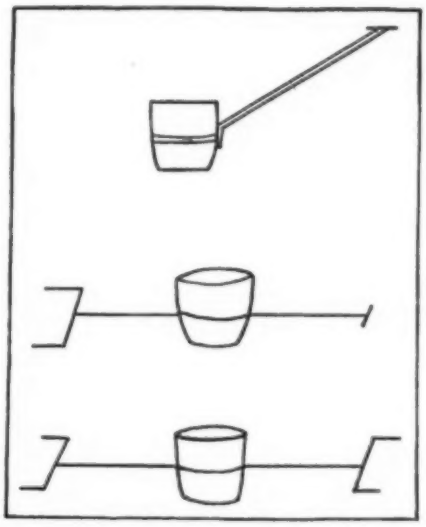


Fig. 284 (Above)—Hand Ladle for One Man. Figs. 285 and 286—Single and Double Shank Ladle for Two Men

In some installations one stationary ladle handles the metal from two cupolas working together or alternately. The pouring spouts of the two cupolas converge at the extremity and discharge metal into the one ladle. To maintain the iron at a high temperature for as long as possible, the ladles are heated before they are used. To protect the bottom lining in a large ladle it is advisable to hold a small hand ladle midway between the end of the pouring spout and the bottom of the ladle for the first two or three minutes, and in that way break the fall of the iron.

After each tap, a thin layer of charcoal is spread with the shovel over the top of the iron, in the ladle. When a sufficient quantity of iron has been collected in the ladle, the top of the iron is skimmed with a skimming iron. With the ladle slightly tilted, anything floating on the surface of the iron is skimmed off on to the floor or into an iron wheelbarrow.

The surface of the iron is covered with fine sharp sand and the pouring is started. If all these preparations have been made carefully, that is, if there is not a particle of slag floating on top of the iron, it is unnecessary to do any further skimming. The layer of sand on top of the iron will hinder the formation of slag. Foundrymen sometimes, finding that the iron is too hot, uncover the entire surface of the bath and thus expose it to considerable oxidization. Others again seeing small pieces of slag appear on the uncovered surface imagine that they continue to rise indefinitely to the surface of the iron. They prolong this uncovered stage to purify the iron. This is a useless and even detrimental practice. If it is desired to cool or purify the metal, it may be left standing for a time but should be covered with a layer or film of fine sand just the same.

Slag Is Removed

Above everything else it is necessary to prevent the particles of slag which rise to the surface of the ladle, from entering the mold. That is why the ladle should be skimmed off thoroughly and the metal should be covered with fine sand dust.

Melted iron is a comparatively impure product. By stirring it with a rod, the easily oxidizable elements which it contains form a slag upon coming in contact with the air. The air is renewed just as often as the stirring is repeated. During the time the iron remains in the pouring basin it becomes more and more covered with a layer of slag. It is necessary to prevent this slag from entering the mold. The ordinary basin, of sand or loam, is in the form of a trough which conveys the metal slightly upward to the opening of the vertical runner or sprue. If the metal is at the right temperature, this method of pouring is perfect.

A number of inventors, desirous of securing sound castings, have developed various processes, aimed at preventing the entrance of

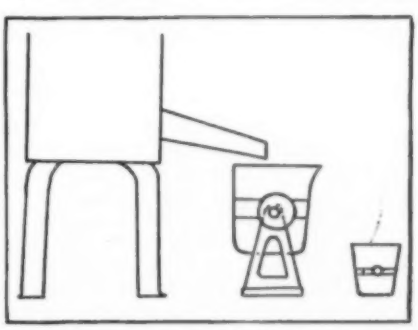


Fig. 288—A mixing Ladle Is Mounted Before the Cupola Spout

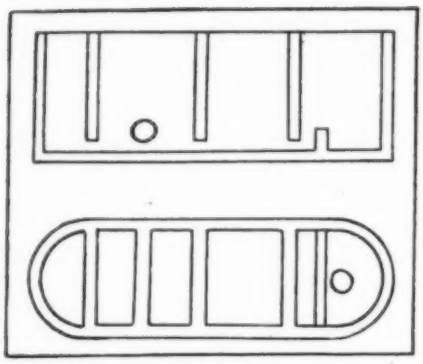


Fig. 289—An Intricate Type of Pouring Basin

slag into the molds. The Schneider process uses a basin made of refractory material, composed of several chambers communicating with each other at their lower ends by winding passages, in which the iron is subjected to a strong agitation. The iron is poured into the first chamber, and passes in turn into the others until it finally arrives at the last in which the sprue is located. The result is that when the iron finally enters the mold it is considerably purified.

The Van Riet process shown in Fig. 290, is characterized by three cylindrical basins, a large one, medium and a small one. The three basins are connected by tangential channels which become narrower as they enter the succeeding basins, to give to the iron a rotary motion at the time of pouring. This motion increases in speed with each succeeding basin. The iron is poured into the first basin. It becomes purified in the second and from the third it enters the upright runner leading to the mold.

In the application of each of the two foregoing processes, the inventors state that the pouring basin should be kept filled continually. If one took the same precautions with the ordinary process the results also would be excellent.

Many special methods are ingenious, but only rarely are they used in the ordinary foundry. The reason is simple. Foundrymen know well that if the men were to take their work a little more seriously, be more careful and more anxious to produce a good job, they scarcely ever would turn out poor castings. One can go ahead without fear of turning out poor work, if he will just exercise elementary precautions.

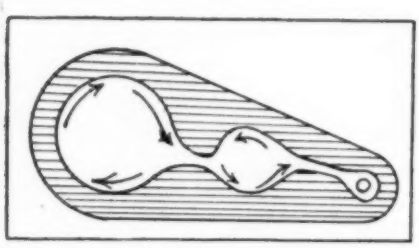


Fig. 290—The Arrows Indicate the Movement of the Metal in This Whirl Gate

Draw the iron from the cupola at a high temperature. Skim the ladle carefully. Cover the exposed surface with fine sand to protect the iron from oxidation. Pour rapidly and keep the pouring basin full up to the edge. If the metal comes out of the cupola cold or pasty, or if the iron has become chilled in the ladle, good castings cannot be expected. It would be preferable to dump the iron on the floor or in a pig bed. No special gating process would do any good in a similar case. Neither would they prevent the formation of blowholes.

Blowholes only come from metal that is poured cold. The gases which develop in the mold, at the instant the iron enters it, remain occluded because the iron congeals before the gases can escape. Reference here is to the real blowholes sorrowfully familiar to the foundryman and machinist, and not of the cavities of every nature found in castings and which the uninitiated also call blowholes. The true blowhole is easy to avoid, it is caused by low temperature and consequent lack of fluidity in the iron.

Select Point of Entry

From the pouring basin the iron arrives at the gate with a section double that of the runner. The point at which the iron enters the mold should be selected with care. Wherever possible this should be at a point on the casting which will not be subjected to any machining. The continuous agitation of the iron causes a deposit of slag to form where the iron enters the mold and might spoil the casting.

Untiring activity of seekers after sound castings has developed a process not very extensively used in Europe, but generally applied in America. As in the other processes, the purpose of this is the prevention of slag entering the mold. The advantage over the patented processes is that it exerts its action on the iron at the moment it is about to enter the mold. This method, illustrated in Fig. 291, is characterized by the following points:

Instead of one pouring sprue, three are set up in the form of a triangle. The gate channel has the form of the letter *Z*. One of the openings serves for pouring. A gate passage is cut from the first sprue *A* to the second, *B*, another from the second to the third, *C*, and a third channel connects the third sprue *C* to the casting. The two vertical sprues *B* and *C* remain open and collect the slag formed on pouring.

Another pouring process consists in directing the stream of iron from the pouring sprue *B*, Fig. 292, toward a chamber *C*, with a spherical form and

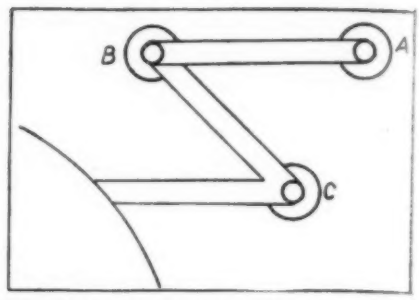


Fig. 291—The Metal Passes from A to B and Then to C Before It Enters the Mold

surmounted by a riser. From this chamber *C* where the iron enters at a tangent, a channel *A* conducts the purified iron into the mold. This method should become more generally used. It presents many advantageous features.

When setting up a molding stand the ease with which flasks and sand can be brought up to it obviously should be studied with care, but satisfactory pouring conditions also should be kept in mind. The iron has to be brought to the mold as quickly as possible.

Care therefore should be exercised to arrange the flasks in a row so that the pouring heads or basins will all be on the same side. There is nothing more detrimental to the success of the castings than to oblige the men to step over flasks and to find some way after considerable trouble, to get at the runner.

Flasks which have to be weighted or clamped are placed so that a sufficient number are ready to take all the iron in the ladle. For example, a whole row of flasks may be weighted and as they are poured, the weights are moved over on to the next row. The weighting could thus be done alternately, that is, weight the first, the third, the fifth, and so on, and as soon as the flasks are poured, set the weights on the even numbers.

Heat developed by the risers must

(*Concluded on Page* 104)

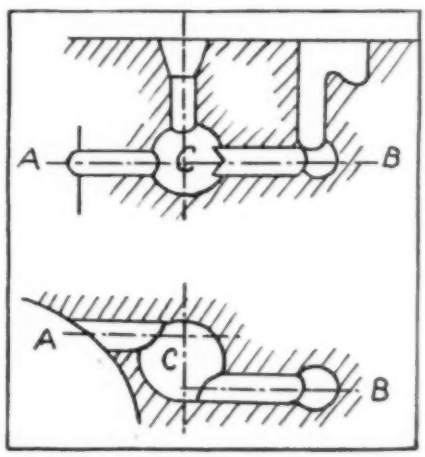


Fig. 292—Plan and Sectional View of Skimmer Gate

Dr. Richard Moldenke Is Dead

DR. RICHARD MOLDENKE for the past 40 years one of the outstanding foundrymen of the United States and enjoying a similar reputation in many foreign countries, died Monday Nov. 17, at Muhlenberg hospital, Plainfield, N. J., after a few weeks illness. In the passing of Dr. Moldenke the foundry industry suffers the loss of an able foundryman, a keen student and a warm friend. His attitude toward the foundry industry is reflected in the dedication of his famous book, *Principles of Iron Founding*: "To the foundrymen of America, with whom I have worked, from whom I have learned, to whom this book—the result of a life of toil and mayhap some achievement is dedicated, in grateful memory of unvaried kindness constantly received."

The same kindly sentiment is found in a sentence from his speech of acceptance at the Syracuse, N. Y., convention of the American Foundrymen's association, where he was presented with the Seaman metal in recognition of his untiring zeal and valuable contribution to the foundry industry. He said: "Tonight as I stand here with my feet definitely pointing westward, for I am no longer young, my life is brightened by the golden rays of this beautiful present, by the generous warmth of your wonderfully friendly feeling toward me as I have reached the end of a long and, I hope, useful but very stormy career. I assure you that I appreciate all this wonder, fully."

Later, the same evening, referring to the value of education and constant study he paid tribute to his father and displayed the humility of the true student, ever cognizant of the great truth that the field of knowledge is limitless. "Success" he said "especially in the foundry, the technical part of it, is based on preparation, research, investigation, development. It must have a sound basis of fact. It must have a wide range of information. I thank my father because he put me to school when I was three years old—and I have been to school ever since. I am just past sixty; that means fifty seven years of school, and I will stay there as long as I live."

Born at Watertown, Wis., Nov. 1, 1864, the son of a Lutheran minister, Dr. Moldenke removed to New York in early life and received his early education in that city. He was graduated from the school of mines of Columbia university with the degree of engineer of mines in 1884. After two years of varied engineering experience, he returned to that university to act as instructor and to qualify for the degree of doctor of philosophy which was awarded him in 1887. Following this he was active in the coast and geodetic survey for the government and was identified with some of the early work in electric power development. In 1889, he organized the mechanical and electrical engineering

department of Michigan College of Mines, Houghton, Mich.

About this time he was offered a position with the McConway & Torley Co., Pittsburgh, which proved to be the starting point in his career as a metallurgist. His experience, coupled with the opportunity for original research, gave him a general knowledge. He worked out the action of carbon, silicon and other basic elements in iron.

In 1897, Dr. Moldenke became a member of the Pittsburgh Foundrymen's association, and a few months later joined the infant American Foundrymen's association. In the latter organization he became associated with such men as Thomas D. West, A. E. Outerbridge, Jr., W. J. Keep, E. H. Putnam, W. G. Scott and others, who were the pioneers both in investigation and dissemination of foundry knowledge.

In 1899, he was prominent in the organization of the Pennsylvania Malleable Co., Pittsburgh, and for a time acted as superintendent of that establishment. At that time, Dr. Moldenke was elected secretary of the American Foundrymen's association, his selection being announced at the Chicago convention in 1900.

His broad experience in practical and scientific matters always was given freely and he felt at all times his responsibility to the industry did not cease with the performance of the routine functions of his office. His restless craving for metallurgical research lead him to originate and follow through some of the most valuable investigations which have been undertaken in the field of foundry science. His cupola study served to revise charging methods and to effect great economies in plant operation. Similarly his study of coke, culminating in an investigation conducted at St. Louis, during the world exposition in that city, led to a new understanding of that basic fuel.

Connection with the American Foundrymen's association brought Dr. Moldenke into international prominence and later through his affiliation with the International and American Societies for Testing Materials, he served on notable committees having for their purpose the investigation and specifying of foundry materials. His latest important work has been in the advancement of an international standard for comparison of cast iron.

Foundry literature, except for a few exceptions, has seen its greatest growth during the lifetime and service of Dr. Moldenke. He has been a most prolific writer on foundry and metallurgical subjects since 1897, his work in these lines ranging from his basic textbook, *Principles of Iron Founding*, through many articles, pamphlets and treatises on commodities used in foundry practice, on methods, and special alloys. A noteworthy book on malleable iron ranks with his *Principles*, previously mentioned as an outstanding achievement in the field.

During recent years, in addition to his technical society work, Dr. Moldenke has acted in an advisory capacity to foundries in this country and abroad and to a number of large manufacturing firms. He was an honorary member of the American Foundrymen's association, the Institute of British Foundrymen, the Pittsburgh, New England and Newark Foundrymen's associations. He was vice president of the American Society for Testing Materials and held active membership in the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Electrochemical society, the British Iron & Steel institute and the German Verein Deutscher Eisen Huttenleute.

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The Shakeout

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¶ Dr. Richard Moldenke

IN THE passing of Dr. Moldenke, the foundry industry loses a valued teacher, counsellor and friend.

His personality has impressed itself upon the present generation and that just passed. His early identification with the American Foundrymen's association and the services which he rendered to that technical organization have been recognized. His advice and counsel to individual foundrymen and some of the larger commercial organizations have been of undoubted benefit to the progress of the industry. His teaching of the art through his writings and contributions to the technical discussions in various association meetings have added to the sum total of foundry knowledge. These attainments will be held in grateful remembrance. His picturesque personality long will be remembered throughout the foundry industry of the world.

¶ Came the Dawn

OPINION generally holds that the slack period variously designated by terms synonymous with depression, soon is due to end. No one is pointing to filled order books. Few factories have gone on double shift operation. No extra dividends have been declared. However, a better tone is evident throughout the business world and in the foundry industry in particular. Depressions never end abruptly. The upward climb to normal is heralded by no sound of trumpets, no battle cries of success. In fact the first few to experience a rising tide of prosperity customarily keep their good fortune to themselves. In times of prosperity a large order is broadcast to the exultant world. In times of depression the same large order is guarded as a jealous secret.

THIS publication, sturdy champion of the foundry industry, declines with thanks the role of business prophet. Such prognostications are better left to statisticians and those upon whom rosey optimism casts a glow of self satisfaction. Nevertheless THE FOUNDRY believes that the tide has passed the low point of the ebb. The return will not reach full flood for many months, in the opinion of many foundrymen. Yet the prevailing low inventories throughout industry show that when castings are needed they will be ordered for rush delivery, particularly if the general business pick up after the first of the year is accelerated.

THE year end is the time for taking stock. A check over of existing equipment is in order. Obviously, many plants have availed themselves of the slow fall season to rehabilitate machinery, repair that which was necessary and replace many obsolete units. Quite aside from the value to general business of buying needed plant equipment at this time, a more selfish interest should show to each prospective purchaser a low range of prices in most commodities.

¶ More Medals Wanted

WHENEVER the question of bravery comes up, some one is sure to quote the famous saying touching on the bravery of the first man who ate an oyster. The originator of that classic remark probably overlooked one important factor. At this late date one cannot be too dogmatic, but one may be pardoned for harboring a more or less reasonable suspicion that the aforesaid hero was cruelly beset by the gnawing pangs of hunger when he absorbed the—at that time—nauseous morsel.

HUNDREDS, perhaps thousands, of instances are on record where men in the foundry industry have braved tradition and long established custom in the production of castings. Occasionally, where a man has been his own boss, he has made the plunge without active opposition, but invariably he has had to do it in the face of tacit disapproval and gratuitous advice to the effect that his proposed course is hopeless if not actually suicidal. In many instances he is confronted by the most violent opposition.

WITHOUT discounting by one jot or tittle, the bravery of the first oyster eater, we submit that a belated medal also is due the first man who cast an automobile cylinder in a green sand mold. A medal with two clasps would not be out of place for the first man who risked pouring steel into a green sand mold. The man who first up-ended a pipe mold and poured it in that position was of the stuff of which heroes are made and the man who first poured green sand molds on a moving conveyor was endowed with the heart of any man who ever earned a medal by leading a forlorn hope or storming the walls of a fortified city.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

FRANK Bonnievier, formerly assistant foundry foreman, Fox Furnace Co., Elyria, O., has been appointed assistant foundry superintendent, Forest City-Walworth Run Foundry Co., Cleveland. Mr. Bonniever became connected with the foundry industry when he was 15 years old and served his time as helper, coremaker, and molder under his father in Sweden. He has had a wide experience both in the United States and Sweden. Coming to the United States in 1922, he worked successively in Massillon, O., Pittsburgh, and Seattle, Wash. In 1925 he returned to the eastern part of the country and was employed in the jobbing foundry of the Ford Motor Co., Fordson, Mich. In June 1926, he became associated with the American Radiator Corp., Buffalo, as asistant foundry foreman at the Austin Arcola plant. He left the employ of that company to accept a similar position with the Fox Furnace Co., Elyria, O., in June 1928 and on May 31, 1930 accepted the position which he now holds. Mr. Bonnievier is a McLain system graduate.

Walter Chatfield, formerly foundry superintendent, Layne & Bowler Inc., Memphis, Tenn., now holds a similar position with the Lorain Castings Co., Lorain, O.

Charles A. Walouke formerly connected with the Forest City-Walworth Run Foundry Co., Cleveland, now is associated with the Caterpillar Tractor Co., Peoria, Ill.

B. D. Spofford, formerly advertising manager, Waco Aircraft Co., Troy, O., has been appointed advertising and publicity manager, Duriron Co. Inc., Dayton, O.

A. M. Cornell has resigned as works manager of the High Bridge, N. J. and the Easton, Pa., plants of the Taylor-Wharton Iron & Steel Co. He will return to Chicago to engage in business for himself.

John Howe Hall, formerly metallurgical engineer. Taylor-Wharton Iron & Steel Co., High Bridge, N. J., has been appointed technical assistant to the president. Mr. Hall will supervise all research activities, check manufacturing methods and sales engineering.

Gottfrid Olson, formerly foundry superintendent, Illinois Malleable Iron Co., Chicago, who for the past three years has been general manager, Katrineholm works, Pump Separator Co., Stockholm, Sweden, has returned to Chicago and again is associated with the Illinois Malleable Iron Co.

Stephen L. Carroll, for the past 6 years superintendent of foundries, Calumet Foundry & Machine Co., East Chicago, Ind., has become associated with the alloy division of the Ohio Steel Foundry Co., Springfield, O. Prior to his connection with the Calumet Foundry & Machine Co., he was foundry superintendent of the George B. Limbert Foundry, East Chicago, Ind.

L. A. Kleber has been appointed superintendent of the High Bridge plant, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., succeeding H. R. Lange, resigned. Mr. Kleber has been superintendent of the foundry at the Taylor-Wharton company's Easton, Pa., plant. Stanley Apgar, formerly superintendent of the High Bridge foundry, will succeed Mr. Kleber, as superintendent of the foundry at Easton.

A. B. Root Jr., past president of the American Foundrymen's association, has been appointed A. F. A. representative on the mechanical standards advisory committee of the American Standards association, New York. Mr. Root is an active member of the A. F. A. and has served the association as president, vice president, director and as a member of several committees. He is a member of the advisory board and the board of awards. Mr. Root is assistant general manager, Hunt-Spiller Mfg. Corp., Boston.

John H. Miller, formerly connected with the General Steel Castings Co., Eddystone, Pa., has resigned. Mr. Miller was associated with the American Steel Foundries, Alliance, O., as special apprentice and later in the engineering department for several years. He left that company in December, 1928, and accepted a position with the Electric Furnace Co., Salem, O. Seven months later he resigned that position to become associated with the General Steel Castings Co., Eddystone, Pa., in the engineering department. He held that position until his recent resignation.

S. R. Robinson, metallurgical engineer, Ohio Steel Foundry Co., Springfield, O., has been appointed chairman of the committee of the steel division of the A. F. A. which is to organize the shop operation course for steel foundrymen at the 1931 convention in Chicago. Mr. Robinson formerly was associated with the Industrial Brownhoist Corp., Cleveland at the Bay City, Mich. plant which recently was taken over by the Ohio Steel Foundry Co. He was one of the leaders of the steel shop operation courses at the 1930 convention in Cleveland.

Dr. Victor O. Homerberg, associate professor of physical metallurgy, Massachusetts Institute of

Looking Ahead to 1931

STARTING January 1, 1931, THE FOUNDRY will present a comprehensive series of articles on the subject of gates and runners. The basic interest of this series is evident to all engaged in the foundry industry. The articles will be valuable to molders, foremen, superintendents, technical men and managers alike, as they relate directly to a fundamental factor in the production of good castings.

Experience has shown that practically 20 per cent of the difficulties encountered in castings manufacture may be traced to faulty gating. For this reason a complete study of the subject such as is offered by this series of articles will prove unusually valuable.

Pat Dwyer, the author of this series, was a practical molder, foreman and foundry superintendent and for the past 12 years has been in close touch with all phases of foundry operation through his position as engineering editor of THE FOUNDRY.

Watch for this series starting January 1 and appearing periodically in succeeding issues.

Technology, Boston, has been appointed technical director, Nitralloy Corp., New York. Dr. Homerberg received his B.S. degree in chemical engineering and his doctor's degree in metallurgy at Massachusetts Institute of Technology. He has been consulting metallurgist for several manufacturing companies and has been engaged in research pertaining to the nitriding process. Dr. Homerberg is the author of many articles on physical metallurgy and metallography and is the co-author of a text book entitled "Principles of Metallography."

A revision of the American standard "Safety Code for the Installation of Pulverized Fuel Systems," has been announced by the American Standards association. The increase in the use of pulverized fuel in many industries resulting in new developments in methods and design of equipment, is responsible for the revision.

OBITUARY

John E. Perry, aged 52, formerly chairman of the board of directors Valley Mold & Iron Corp., Hubbard, O. and Sharpsville, Pa., died Nov. 11. He was born in Athens county, O., and was well known throughout the foundry industry. At one time he was associated with the Brier Hill Steel Co., Youngstown, O., as head of the mining and transportation department. In April 1917, he became assistant to the president, Republic Iron & Steel Co., Youngstown, and in July of the same year was appointed president of the Wharton Steel Co., Wharton, N. J. He next became president of the Valley Mold & Iron Corp. While he was president of that company, plants at Hubbard, O., and South Chicago, Ill., were built.

Wm. G. Carlin, 61, formerly associated with Thomas Carlin Sons Co., Pittsburgh, manufacturer of foundry supplies, died at his home near Salem, O., Nov. 8.

John A. Cordray, proprietor, J. A. Cordray Foundry, Charleston, S. C., died Oct. 12, at Charleston. He was 55 years old and had been connected with the foundry industry for 30 years.

Henry Lang, 66 vice president, Ingersoll-Rand Co., New York, died Nov. 10 at Montclair, N. J. He also was connected with Lang-Kidde Co., New York, a foreign trade concern, and Island Service Co., Nantucket, Mass. He was a native of Martinsburg, W. Va.

Charles M. Eddy, 52, president, R. M. Eddy Foundry Co., 372 West Grand avenue, Chicago, died Nov. 10. For about 20 years he was secretary-treasurer of the foundry company and at the retirement of his uncle, George D. Eddy, he became president. Mr. Eddy's grandfather, Robert M. Eddy, founded the company which

Foundry Association Directory

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago. Annual meeting, Stevens hotel, Chicago, May 4-7, 1931.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. Bonner, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. Evans, Continental Roll & Steel Foundry Co., East Chicago, Ind.; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, William J. Muhlitner, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Ft. Shelby Hotel.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Assistant Director, C. N. Ring; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; manager, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue.

Newark Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting dates: Dec. 3; Jan. 28; March 25; May 27.

New England Foundrymen's Association

President, Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.; secretary Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings held the second Wednesday of each month. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, A. H. Kramer, Advance Foundry Co., Dayton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland. Annual meeting Nov. 13 at Columbus, O.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. Troutman, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad City Foundrymen's Association

President, R. L. Eichman, Bettendorf Co., Bettendorf, Ia.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, Horace R. Culling, Carondelet Foundry Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. Orphan, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, Edward C. Gustin, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

formerly was known as the Globe Foundry Co. His father, the late Alfred Eddy, also served as president of the company.

Charles H. Booth, 69 for many years vice president, United Engineering & Foundry Co., Pittsburgh, in charge of its Youngstown properties died Nov. 6. He retired as chairman and member of that company's executive committee in 1917 and two years later retired from its board of directors.

Edward Conrad Waldvogel, vice president and director, Yale & Towne Mfg. Co., Stamford, Conn., died Nov. 13 at New Rochelle, N. Y., following a short illness. Mr. Waldvogel was born in Toledo, O., and entered the service of the Yale & Towne company in 1905 as a salesman. In 1910 he was transferred to New York as assistant to the general manager and became assistant general manager in 1912. He succeeded Walter C. Allen, president of the company, as general manager in 1916. Mr. Waldvogel was elected a director of the company on March 11, 1920 and on March 8, 1923 became vice president in charge of sales.

Harry F. Wahr, 47, president Mesta Machine Co., West Homestead, Pa., since Sept. 15, 1925, when he succeeded the late Frederick E. Mesta, died at West Homestead, Pa., Nov. 5. He was a nephew of the founder of the Mesta company. After graduating from Western University of Pennsylvania, now University of Pittsburgh, with an M. E. degree, Mr. Wahr entered the Mesta company's engineering and metallurgical departments. In 1908 he was made assistant sales manager in charge of estimating. Promoted to sales manager, in 1911, he was also made assistant secretary. The following year he was elected secretary and a director, retaining the sales managership. During the World war he handled many large governmental contracts for the company and when George Mesta died in April, 1925, he was elected vice president, succeeding Frederick E. Mesta, who then was advanced to the presidency.

Henry Harnischfeger, president and one of the founders. Harnischfeger Corp., Milwaukee, died Nov. 15. Mr. Harnischfeger was 75 years old and was born in Salmuenster, Germany. After serving an apprenticeship to a locksmith, he came to the United States at the age of 16 years. For 10 years he was employed as tool maker in the Singer Sewing Machine Co., plant at Elizabeth, N. J. He went to Milwaukee in 1881 to become foreman of the milling machine department of the Whitehill Sewing Machine Co. Mr. Harnischfeger and Alonzo Pawling; who was employed at the same plant, decided to form a partnership to do general machine work. In 1887, the partnership made its first crane for the E. P. Allis Co., now the Allis-Chalmers Mfg. Co., Milwaukee. Shortly after the Shaw Electric Crane Co. was formed which later was changed to the Pawling & Harnischfeger Co. and in 1914 the present name of the

Henry Harnischfeger

company was assumed. Mr. Harnischfeger was well known for his philanthropies and recently set aside a fund for the benefit of his employes.

Prominent Foundryman Dies in Atlanta

James M. Hollowell, for many years vice president and general manager, Spalding Foundry Co., Atlanta Ga., and one of the best known foundrymen in the South, died at his home in Atlanta after a brief illness, Oct. 29, 1930. The late Mr. Hollowell was born Jan. 9, 1870, in Autagua county, Alabama, where his father was superintendent of the Shelby blast furnace and where the son acquired his first knowledge of iron and its uses. In his early youth he served an apprenticeship at the trade of molding and then went through the University of Alabama with the class of 1890. He specialized for two years in civil and mining engineering.

For several years he worked in foundries scattered over a wide area and developed to a marked extent the attributes of self confidence and poise that later stood him in good stead in controlling the growth and operation of the plant in which he has been interested since 1904. A genial personality contributed to his success and carried him far on the road to the acquisition of friends not only in the foundry industry, but outside of it.

A craving for knowledge and a nice taste in reading in his youth were cultivated and expanded over a wide field in the passing years. This in turn enabled him from time to time to enjoy one of his pet hobbies, writing for the technical press and other publications including THE FOUNDRY. He was widely known among business and civic leaders of Atlanta and was a member of the democratic city executive committee at the time of his death.

Mr. Hollowell is survived by his widow, a daughter, Mrs. J. M. Fant; three sons, Charles, Harold and J. F. Hollowell, and three sisters. Harold H. Hollowell is secretary-treasurer of the Spalding Foundry Co.

AluminumCastingsMade by Improved Practice

(*Concluded from Page* 75)

of surface shrinkage which often is attributed to poor quality of metal. This type of shrinkage often occurs on thin flat sections and is due to an insulating layer of gas which retards the speed of solidification.

That condition has the effect of creating an area which solidifies later than the surrounding areas and therefore is isolated from the source of feeding metal. The result is an area of inter-granular shrinkage which becomes prominent because of a larger grain size induced by the slower speed of solidification. In such instances, hard ramming has resulted in the production of a casting containing areas of unsoundness and decreased strength.

Other factors which contribute to low permeability are high moisture content and the presence of too much fine material in the sand. Both of these factors tend to make the sand pack more tightly under ramming, thereby closing the pores in the sand. Under the head of fines are classed clay bond and particles caused by disintegration of the sand after repeated use.

Has Valuable Properties

(*Continued from Page* 79)

ings are exceptionally free from internal defects.

Risers are used to feed castings. The object is to transfer the *pipe* cavity to the risers, using these as reservoirs to supply liquid metal to the points at which solidification shrinkages effects are most likely to occur. Unfortunately, perhaps because of lack of recognition of the principles involved we find many risers and gates *are fed by the casting* rather than the proper reverse procedure. The more a riser pipes, draws down, the more effective it is. A riser which does not pipe is not doing any good except as a possible flowoff for dirt and quite likely is doing harm.

Proper gating is essential to production of sound castings. Remembering always that the iron in the casting is hottest just as it enters

from the gate, it is obvious that the gates in a casting of nonuniform section if possible should lead into the thinner sections. The metal then, entering heavier sections is at a lower initial temperature. That counterbalances to some degree the retarding effect on the cooling rate exerted by the greater mass of metal, and helps equalize cooling rates between thin and heavy sections.

WisconsinFoundersHear Talk on Unemployment

The regular monthly meeting of the Wisconsin Gray Iron Foundry group was held at the Schroeder hotel, Milwaukee, Nov. 12. The meeting was addressed by Prof. D. D. Lescohier, executive secretary, Wisconsin citizens' committee on unemployment. The Wisconsin group is the first major business group to hear Prof. Lescohier, who is a nationally known economist and specialist on employment and labor problems. He is a member of the faculty of the University of Wisconsin and has been loaned to Gov. Kohler to aid the unemployment situation.

Prof. Lescohier told of the progress that has been made and outlined the program that has been worked out to provide emergency relief during the winter. He stressed the need for exhaustive study of employment problems as related to the foundry industry. Prof. Lescohier declared that the country was facing the problems of unemployment in a definite way for the first time in its history.

The speaker was of the opinion that the problem was too large to be solved by direct attack but that constant consideration would tend to reduce it to a large extent. He told the group that foundrymen were the only ones who could solve the unemployment problem in the foundry industry since they understood its problems best. In closing he urged co-operation in the solution of the problem of unemployment.

Practice Fundamentals

(*Concluded from Page* 98)

be taken into consideration and the weighting of the flasks arranged in such a manner that the men are never in danger of being burnt while shifting the weights or pouring the iron.

As soon as the metal has solidified in the molds, the weights are removed, or the clamps, hooks, etc. are taken off. In many foundries this operation is performed with special equipment after the regular day's work or in the morning.

It is advisable insofar as manufacture will permit to open the molds, take out the castings, replace the flasks in storage, wet and prepare the sand, all outside of the regular working-hours, to enable the molders to work usefully on production. The advantages of various methods should be taken into consideration in each particular case.

Serves One Company for 68 Years

Herman Weber, connected in various capacities for the past 68 years with the Barnett Foundry & Machine Co., Irvington, N. J., retired on pension Oct. 31 of the present year. He began his career as an office boy with the company April 6, 1862. Five years later at the age of 19 he entered the core room and

Herman Weber

remained in that department for 12 years. Desire for a more comprehensive knowledge of casting production led him to serve an apprenticeship at molding and melting. At the close of 25 years service with the company he was appointed foundry superintendent and he remained in that position for 25 years. At a testimonial dinner tendered by the company to mark the completion of 50 years of faithful service, Mr. Weber was presented with a gold watch by the company and with other gifts by the employes in token of the high esteem in which he was held by the management and by the men whose activities he directed. At that time also he was relieved of the strenuous duties incident to his position as foundry superintendent and was appointed foreman of the pattern shop. He held that position until Oct. 31.

Birmingham Chosen for Regional Meeting

The second regional meeting, sponsored by the American Foundrymen's association, will be held in Birmingham, Ala., Jan. 20 and 21, 1931. The first regional meeting was held at Moline, Ill., March 26, 1930 in co-operation with the Quad-City Foundrymen's association. No similar association exists in Birmingham but foundrymen in the district are co-operating with the A. F. A. to make the meeting a success. Birmingham is the largest foundry center in the South having 29 foundries and a large number in the surrounding cities. The state of Alabama ranks fourteenth in the United States in number of foundries, with 98 foundries. The Birmingham district is the largest cast iron pipe producing section in the United States. A large tonnage of fittings also is made there, as well as many other foundry products.

Although the schedule for the meeting has not been announced definitely, the tentative program calls for a series of plant visitations on the first day and a program of technical papers on gray iron, steel, malleable and nonferrous foundry practice on the second. Leaders in the various foundry fields will have charge of the sessions.

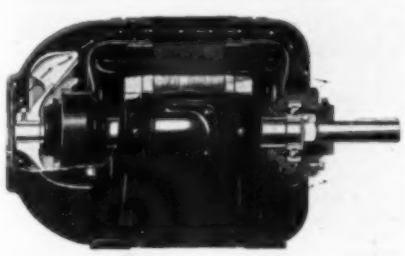
Testing Society Will Meet in Chicago

The annual meeting of the American Society for Testing Materials will be held at the Stevens hotel, Chicago, from June 22 to 26, 1931. It is expected that the meeting will differ somewhat from previous annual meetings since it is being held in the center of a great industrial and engineering community, and the program is being developed with that in mind. Two joint sessions are being planned. One will be with the Western Society of Engineers in which it is planned to discuss the significance of specifications in certain major, and in a sense key, industries of the district. The other will be a joint meeting with the American Society of Mechanical Engineers in the form of a symposium on the effect of temperature on the properties of metals. The subject of the engineering properties of castings also is being developed in co-operation with the American Foundrymen's association, and it is expected that some phase of that general subject wil be ready for presentation.

According to the bureau of mines report on *Fluorspar and Cryolite in* 1929, 3498 short tons of fluorspar valued at $69,712 was used in the foundry industry. That constitutes 2.39 per cent of the total tonnage of 146,439 mined in 1929.

Enclosed Motor Cooled by External Fan

General Electric Co., Schenectady, N. Y., recently introduced a new type, totally enclosed motor which is dust tight and fan cooled. It is equipped with ball bearings in convenient cartridge housings and a single ventilating fan located outside the enclosure. The new line of totally enclosed motors provides a unit of that type of the same dimensions, rating for rating, as the standard open type, horizontal, general purpose motor from ¾ to 50 horsepower at various speeds. Size and weight have been minimized in the new line. A single ventilating fan is located outside the motor enclosure on a short shaft extension and on the opposite end from the drive. A double frame is used providing passages for the ventilating air. All

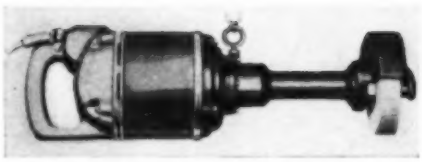


Construction of the Motor Has Been Simplifed

enclosing parts are of steel or gray iron construction. The fan is housed in a gray iron enclosure with a heavy screen guarding the intake opening. Necessary disassembly or reassembly of the motor is facilitated by simplified mechanical construction. Dust tight, cartridge type ball bearing housings are a further aid and permit the removal of the motor without exposing the bearings to dust or dirt. The motor is endorsed by the Underwriters' Laboratories for hazardous dust conditions.

Electric Grinders Have Induction Motors

Hisey-Wolf Machine Co., Cincinnati, announces a new line of heavy-duty portable grinders, rated at 1 and 2 horsepower. These grinders, one of which is shown in the accompanying illustration, are equipped both with single-phase motors for lamp socket connection, and with two and three-phase motors for connection to power line circuits. Direct-current motors also can be furnished. The single-phase machines have improved commutating type repulsion induction motors, which do away with the dragging centrifugal switch. They will instantly pick up speed under loads within twice their rated capacity.



Heavy Duty Portable Grinders Have Antifriction Bearings

Their starting current demands are unusually low also, and low voltage has no objectionable effect upon them.

These grinders are designed throughout for heavy duty, motors being rated for continuous duty and all parts being generously proportioned. Ball bearing motors are used and the grinding spindles are carried on tapered roller bearings. The manufacturer points out the advisability of using a 1-horespower and a 2-horsepower grinder in conjunction, the 10-inch wheels being transferred from the 2-horsepower to the 1-horsepower machine as soon as they are worn down to 8 inches. This induces grinding efficiency by maintaining approximately correct surface speeds, and makes for abrasive wheel economy.

Sand Blast Helmet Is Made of Rubber

Pangborn Corp., Hagerstown, Md., recently placed a new type sandblast helmet on the market. The new unit is made of rubber and protects the operators eyes, flesh and lungs. The helmet, shown in the accompanying illustration, is equipped with a curved window to give true vision. The window is protected by a bulged screen and both glass and screen may be replaced easily. Fresh air, which is piped into the back of the helmet at any desired pressure, is kept circulating and a fixed jet above the special sweat band cools the head. Air is sprayed on the outside of the window through holes above it. That feature keeps dust from fogging the window. An air washer, which supplies the operator with clean, washed air practically at atmospheric pressure, may be attached to the helmet. That apparatus also is manufactured by the Pangborn Corp.

The Helmet Is Well Ventilated and Protected

Quad-City Foundrymen Hear Arnold Lenz

Arnold Lenz, manager, Chevrolet Motor Co., gray iron foundry division, Saginaw, Mich., was the speaker at the regular monthly meeting of the Quad-City Foundrymen's association, held at the Davenport chamber of commerce, Davenport, Iowa, Nov. 17. The meeting was attended by 124 foundrymen of the district.

Mr. Lenz discussed the practices and policies in his plant. He introduced his subject, "Modern Foundry Practice," by giving figures to show the size of the plant, the importance of small savings, and the amounts represented as savings in a year's production. Details must be watched with the utmost care. That point was brought out when he quoted figures to show the monetary advantage of saving 0.1 per cent scrap. He said that tonnages produced afforded large savings in purchasing material and efficient operation.

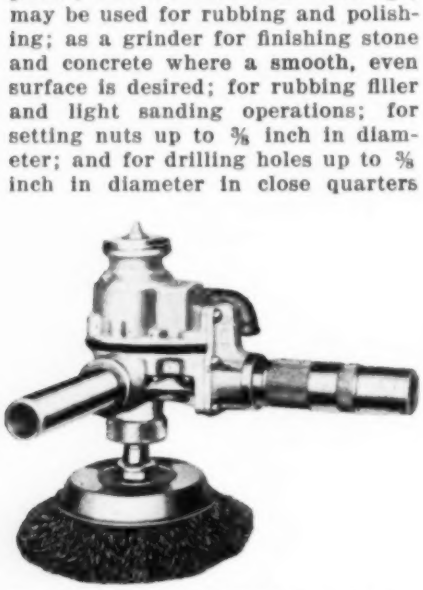
Pattern shop practice has been developed to obtain the specialized talents of various men for particular tasks. Layout men are speedy in tranferring information from blue prints to materials. Experts in various machine operations perform the necessary work progressively until the job is completed. That plan has provided uniform patterns in which copes and drags are interchangeable. Melting, while performed similar to accepted practice, produces hotter iron which reduces many complaints usually attributed to faulty metal.

Personnel and working conditions were discussed and the training of men for the specialized positions offered in the plant. That work is carried out by apprentice training. Apprentices are trained under somewhat primitive conditions, according to the speaker, to thoroughly ground them in the fundamentals of the trade they are studying.

The principal dimensions of steel base flanged fittings for maximum working steam pressures of 250, 400, 600 and 900 pounds per square inch are given in a tentative draft of a proposed standard sponsored by the American Society of Mechanical Engineers, American Standards association, Heating and Piping Contractors' National association, and the Manufacturers' Standardization Society of Valve and Fittings Industry.

Air Driven Tool Has Numerous Uses

Rotor Air Tool Co., 5704 Carnegie avenue, Cleveland, recently developed a new air driven tool which may be used for a variety of operations. The tool, shown in the accompanying illustration equipped for wire brushing in the removal of paints, rust and sand from castings; may be used for rubbing and polishing; as a grinder for finishing stone and concrete where a smooth, even surface is desired; for rubbing filler and light sanding operations; for setting nuts up to ⅜ inch in diameter; and for drilling holes up to ⅜ inch in diameter in close quarters



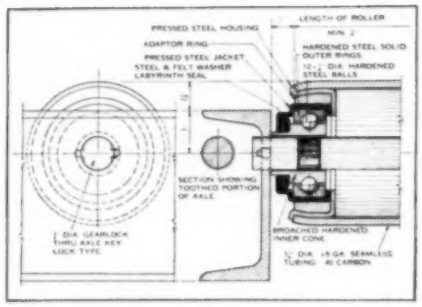
The Tool Is Light Weight and May Be Used for Six Different Purposes

where there is small clearance. The tool weighs 6 pounds and may be obtained with speeds of 1000, 1500 or 2000 revolutions per minute as desired.

Conveyor Is Built for Severe Service

Mathews Conveyor Co., Ellwood City, Pa., has developed a heavy duty roller conveyor for foundries and other plants where severe service is encountered. Features of the new units include gear teeth on inside of cone and knurling on the axle to prevent the cone from turning; an upset key fitting into a corresponding slot in the frame rail which prevents the axle from turning; special, dust-proof, steel and felt washer labyrinth to protect the bearings from sand and dust; heavy duty solid ball races; heavy gage 0.40 carbon seamless steel tubing and frame rails of angle or channel iron construction.

Bearings are of the detachable, hardened cone type with outer rings. Two general classes of the conveyor are made. In the lighter type, 12 hardened steel balls of ⅜-inch diameter are used while in the heavier model 13 balls of the same type but ½-inch diameter are specified. In both types, balls are assembled in pressed steel jackets. The gear lock cone


PRESSED STEEL HOUSING
ADAPTOR RING
PRESSED STEEL JACKET
STEEL & FELT WASHER LABYRINTH SEAL
LENGTH OF ROLLER
MIN. 2
HARDENED STEEL SOLID OUTER RINGS
DIA. HARDENED STEEL BALLS
SECTION SHOWING TOOTHED PORTION OF AXLE
BROACHED HARDENED INNER CONE
DIA. GEARLOCK THRU AXLE KEY LOCK TYPE
DIA. GA. SEAMLESS TUBING .40 CARBON

A Special Dust-proof, Steel and Felt Washer Labyrinth Protects the Bearings

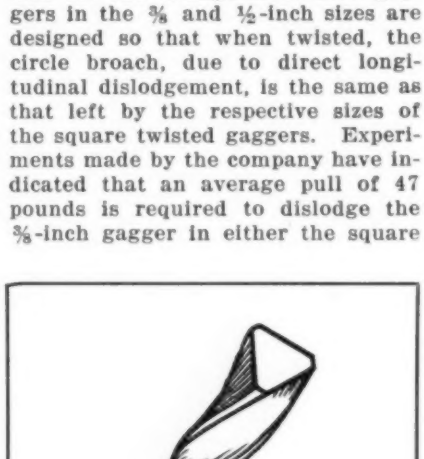
and special washer are added features. Bearings may be packed in grease or for severe service bearings and axles may be fitted for grease gun lubrication.

Axles are of cold rolled steel, ¾-inch diameter in the lighter type and 1 3/16-inch diameter in the heavier model. Both types are equipped with either notched ends or the keylock previously mentioned. Each roller in the lighter type has a continuous load capacity of 600 pounds and in the heavier, 2000 pounds.

Frames are angle or channel iron of proper weight to suit the material conveyed.

Develops New Gagger

The Franklin Core Rod & Gagger Co., Franklin, Pa., recently announced an interesting addition to its line of twist-steel gaggers. The new type of gagger, which at present is being made in only the ⅜ and ½-inch sizes, is made from a rolled triangular section of a specially designed steel bar, as shown in the accompanying illustration. The section for the triangular twisted gaggers in the ⅜ and ½-inch sizes are designed so that when twisted, the circle broach, due to direct longitudinal dislodgement, is the same as that left by the respective sizes of the square twisted gaggers. Experiments made by the company have indicated that an average pull of 47 pounds is required to dislodge the ⅜-inch gagger in either the square



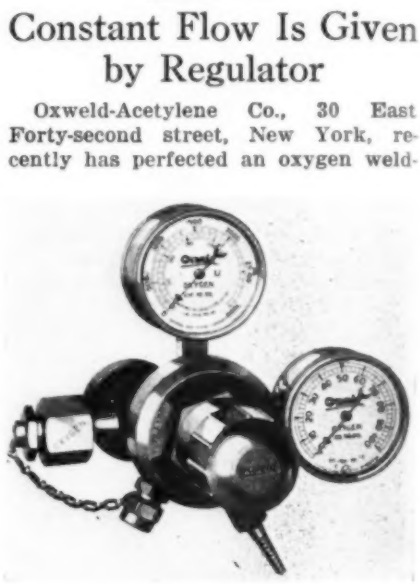
The Gagger Is Made from Rolled Steel Having a Triangular Section

twisted or the triangular twisted form.

However, in the case of the triangular twisted gagger, it is stated that it requires a greater number of gaggers to make a ton. For example, in a ⅜ x 8 x 4-inch gagger, it is claimed that there are 5880 triangular twisted gaggers to the ton, while there are 4160 deformed bars of plain bar gaggers to the ton.

Constant Flow Is Given by Regulator

Oxweld-Acetylene Co., 30 East Forty-second street, New York, recently has perfected an oxygen weld-



Oxygen Regulator Eliminates Line Pressure Fluctuations

ing regulator which insures a constant line pressure free from any fluctuations. This device, an illustration of which accompanies this description, accomplishes two-stage pressure reduction through two separate and independent sets of diaphragms, valves and springs. The full cylinder pressure of 2000 pounds per square inch enters the regulator through a stem-type valve and is controlled by the first stage diaphragm. In this stage the pressure is reduced to less than 250 pounds per square inch, the pressure at this point being nonadjustable and constant for any one regulator, but varying somewhat with different instruments.

The oxygen then passes to a second stem-type valve and diaphragm assembly where pressure is reduced to the working point desired by the operator. This pressure can be regulated by the operator by an adjusting screw, any operating pressure being obtained without fluctuation. Instead of the usual handle type pressure adjusting screw, this instrument has a screw with a ribbed stem, which not only presents a neater and more compact appearance, but avoids possibility of breakage by eliminating projections.

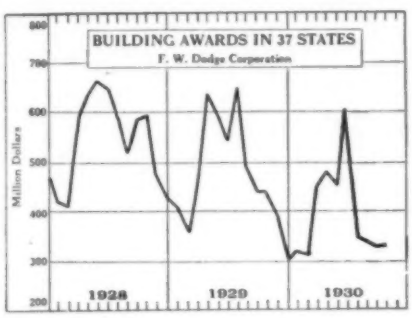
Adirondack Steel Foundries Corp., Watervliet, N. Y., has opened a district sales office at room 426 Park Square building, Boston, in charge of W. W. Weller.

Trade Trends in Tabloid

FOUNDRY operations have held at about the same rate during the past 30 days. However, signs of an early improvement in the industry are appearing here and there. Manufacturers of foundry equipment report an increase in inquiries for various items for replacement and repair purposes. Demand for pig iron appears slightly heavier in some sections, especially from automobile manufacturers located in the Detroit district.

—T—T—

Building construction awards in October registered a slight gain over the preceding month. The total for October was valued at $337,301,400 compared with $331,863,500 in September and $445,642,300 in October, 1929. Contracts let for residential building



during the month were the largest since May.

—T—T—

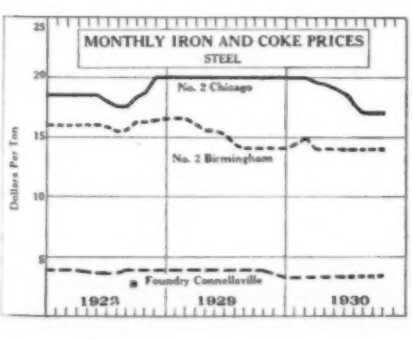
Foundry operations in the Chicago district remain at about 50 per cent. Steel foundries are failing to regain the position realized in the September spurt. Brass foundries are maintaining schedules of about three days a week, with little business booked for operations in the immediate future. Aluminum shops have gained slightly in orders.

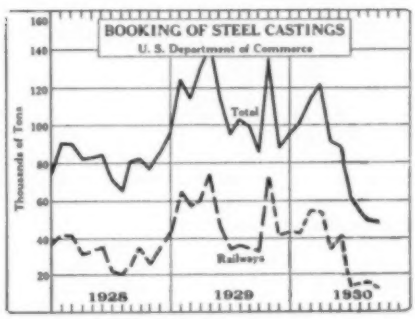
—T—T—

Deliveries of brass and bronze ingot and billets by members of the Non-Ferrous institute in October totaled 6285 tons compared with 5704 tons in September. Unfilled orders on Nov. 1 amounted to 24,723 tons, against 18,386 tons on Oct. 1.

—T—T—

Loadings of revenue freight cars





during the week ended Nov. 1, dropped to 934,640 cars as compared with 959,335 for the week ended Oct. 25. Although loadings have been fluctuating considerably during the past few weeks, no major seasonal decline has developed.

—T—T—

Automobile production during October was estimated at 156,743 units by the National Automobile Chamber of Commerce, compared with 230,888 cars in September and 394,540 in October, 1929.

—T—T—

Approximately 2500 freight cars are actively pending, but orders are lacking. The Virginian railroad recently awarded 600 hopper cars and the Pacific Fruit Express will build 600 refrigerator cars in its own shops.

—T—T—

Recent activity in the automobile industry caused by preparations for new models has resulted in a few substantial orders for machine tools. Inquiry also has increased recently.

—T—T—

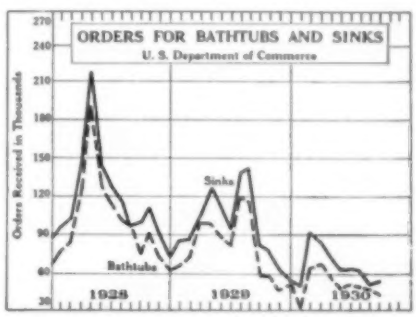
Steelmaking operations were between 43 and 45 per cent on Nov. 20. Youngstown mills lead with a percentage of 52.

—T—T—

Pressure pipe manufacturers in the Birmingham district, in some instances are operating five days a week. Pipe shipments are steady and additional orders are in sight. On the whole, foundries in the district are operating steadily.

—T—T—

Electricity produced in the United States for the week ended Nov. 15 totaled 1,718,137,000 kilowatt hours compared with 1,731,298,000 kilowatt hours the preceding week and 1,810,-



010,000 kilowatt hours the corresponding week in 1929.

—T—T—

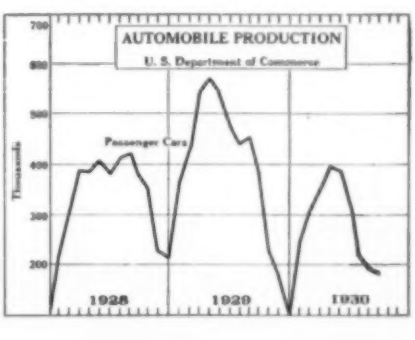
Orders totaling more than $5,000,000 were booked by manufacturers at the joint exhibition of the National Standard Parts and the Motor & Equipment associations, which closed in Cleveland, Nov. 19. This is only slightly under the bookings at separate shows held last year.

—T—T—

Sales made during the third quarter of 1930 by 81 manufacturers of electrical goods totaled $217,818,078 as compared with $276,732,039 for the second quarter and $338,169,678 for the third quarter of 1929, according to the bureau of census.

—T—T—

Demand for pattern lumber is reported to have increased considerably during the past month.



RAW MATERIAL PRICES
November 19, 1930

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$12.00 to 12.50
Heavy melting steel, Pitts.	12.50 to 13.50
Heavy melting steel, Chicago	10.00 to 10.50
Stove plate, Buffalo	9.50 to 9.75
Stove plate, Chicago	6.50 to 7.00
No. 1 cast, New York	8.00 to 8.50
No. 1 cast, Chicago	9.50 to 10.00
No. 1 cast, Philadelphia	13.50
No. 1 cast, Pittsburgh	12.50 to 13.00
No. 1 cast, Birmingham	11.50 to 12.00
Car wheels, iron, Pittsburgh	13.50 to 14.00
Car wheels, iron Chicago	12.00 to 12.50
Railroad malleable, Chicago	12.50 to 13.00
Agricultural mal., Chicago	11.00 to 11.50
Malleable, Buffalo	13.50 to 14.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	10.75
Electro, copper, producers	12.00 to 12.12½
Straits, tin	25.87½ to 26.00
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	13.50
Lead, New York	5.10
Antimony, New York	7.12½
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.30

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Hollywood Foundry & Machine Co., Hollywood, Fla., has been incorporated by N. T. Henjum.

Metal Foundry Corp., Brooklyn, N. Y., has been incorporated by M. Kelitman, 154 Nassau street, New York.

Hub Alloy Casting Co., Findlay, O., recently was slightly damaged by fire. Loss is estimated at $5000.

Thatcher Co., 39 St. Francis street, Newark, N. J., has begun operations after being closed for some time.

Hayes Plump & Planter Co., Galva, Ill., has reopened its plant after being closed several weeks.

Bremen, Ind., plant of the American Radiator Co., New York, has been closed and the equipment has been moved to the Buffalo plant.

Capital District Foundry & Machine Corp., Cohoes, N. Y., has been incorporated with $40,000 capital by MacLean & Neary.

Reeves Stove & Foundry Co., Twenty-second and Hayes avenue, Camden, N. J., which recently was damaged by fire, will rebuild the unit. (Noted Nov. 1.)

The East Gary plant of the Calumet Foundry & Machine Co., East Chicago, has been reopened after being idle for several months. Both plants will operate full time.

A. E. Martin Foundry & Machine Co., 705 Park street, Milwaukee, recently was damaged by fire to the extent of $50,000. Loss was confined to the core room.

Foundry of the Romort Mfg. Co., Oakfield, Wis., recently was damaged by fire. The loss is estimated at approximately $15,000. The damaged unit will be rebuilt.

The name of the foundry operated at Marion, S. C., by Emerson & McDuffie has been changed to the Marion Iron Works. Duncan McDuffie is owner and works manager.

Caroline Foundry, 723 South Caroline street, Baltimore, has closed bids for the construction of a 3-story foundry. W. S. Austin, Maryland Trust building, is consulting engineer.

Charlotte Pipe & Foundry Co., South Mint street, Charlotte, N. C., whose plant recently was damaged by fire to the extent of $100,000, will rebuild all damaged units immediately. W. Frank Dowd is president of the company. (Noted Nov. 15.)

Ames Sword Co., Chicopee, Mass., is being reorganized with plans for manufacturing swords, insignia, and other metal products at another plant. It is believed that the company cast the first bronze statue erected in America. Thomas H. Broeshar is president.

National Foundry, Pontiac, Mich., has taken over the old plant of Eaton Axle & Spring Co., and is remodeling it for the manufacture of pipe and manhole covers. Operations are expected to start about Dec. 1 with 200 men. Bresford Boate is plant superintendent.

Benton Harbor Malleable Industries, Benton Harbor, Mich., recently began the construction of a new foundry. The building, 90 x 25 feet, will replace the wooden structure which was torn down about 4 months ago. It will be of fireproof construction and will cost approximately $25,000.

Schwab Furnace & Mfg. Co., Cedar Grove, Wis., recently suffered a damage estimated at $2000 to its foundry. The cupola and two walls of the building were damaged severely. The Schwab company recently moved to Cedar Grove from Milwaukee. Henry E. Schwab is president of the company.

Canadian Rumely Co. Ltd., 48 Abell street, Toronto, Ont., has been taken over by Alfred Davis and associates. Plant buildings containing 250,000 square feet of floor space will be augmented by the addition of new manufacturing plant.

United Engineering & Foundry Co., Grace avenue, northeast, and Fourteenth street, Canton, O., proposes to extend its plant and add 125 employes. One of the units to be expanded will be the foundry. The cost of erection and equipping the new addition will amount to about $400,000.

Spring Foundry Co., 901 West St. Paul avenue, Waukesha, Wis., William J. Grede, president, will erect a 3-story cupola building, 30 x 80 feet, and a 1-story wing, 40 x 70 feet. Cost is estimated at $50,000. Frank D. Chase, Inc., 720 North Michigan avenue, Chicago, is in charge of construction. (Noted Nov. 1).

General Bronze Corp., 480 Hancock street, Long Island City, N. Y., has prepared plans for a new unified plant near Long Island City to replace its three separate local plants. Erection of the plant will proceed as soon as general business warrants and the company's staff has completed development of new equipment and production methods now being undertaken.

American Cast Iron Pipe Co., Birmingham, Ala., is completing its new centrifugal pipe casting shop which is scheduled to be in operation early in the new year. The new construction is of brick and steel and will have a maximum capacity of 600 tons of cast pipe daily. Pipe will be made in 14, 16, 18, 20 and 24-inch sizes. Sixteen foot lengths of the bell and spigot type with a bead cast on the spigot end will be manufactured. (Noted June 1.)

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., has completed additions to its plant at a cost of more than $300,000. A cleaning room, 65 x 140 feet, has been built which also houses a 2-car type annealing furnace. Molding machines and sand conveyors have been installed in the main foundry building. A 10-ton air furnace for production of iron rolls has been added to the roll foundry. A pattern storage building 40 x 200 feet has been added, and various machine tools have been relocated.

According to recent reports, a number of foundries in Maine have maintained a good rate of operations during the greater portion of the year. The following plants are included in that group: Hallowell Iron Foundry, Hallowell; J. W. Penny & Sons Co., Mechanics Falls; J. F. Hodgkins Co., Gardiner; Record Foundry & Machine Co., Livermore Falls; Noyes Stove Co., Waterville; Waterville Iron Works, Waterville; and Getchell Foundry & Machine Works, Oakland. Clark Foundry Co., Rumford, has been working 4 and 5 days all year and is extremely busy at present. Androscoggin Foundry Co., Auburn, has averaged 4 days per week during the year.

Whiting Corp., Harvey, Ill., has been awarded the contract for five, 5 x 15 foot sluice gates; one, 8-foot and two, 6-foot overflow gates; thirty, 6-inch plug valves; operating mechanisms; drive-shafting and other equipment for the Hill View reservoir by the board of water supply, New York. Nearly 100 tons of iron castings are included in the contract. The majority of the tonnage will be made in the Birmingham, Ala., plant. The board will ask bids before the first of the year on at least 18 hydraulic sluice gates and bronze castings, some of which will be of extremely large dimensions. The total weight of bronze castings to be awarded will amount to several hundred tons.

Trade Publications

CRANES—Whiting Corp., Harvey, Ill., has issued a folder on its high-lift, low-headroom cranes. Gearing, clearances, lift, brakes, bearings, lubrication and accessibility of the equipment are discussed.

ELECTRIC TOOLS—Standard Electrical Tool Co., Cincinnati, is distributing a new, 8½ x 11-inch, 64-page catalog No. 36. A number of new tools are featured and descriptions and illustrations of the complete line of electric drills, grinders, buffers and polishers are included.

ELECTRIC MOTOR—A bulletin by the Allis-Chalmers Mfg. Co., Norwood, O., describes its totally-inclosed, fan-cooled motor for use where dust, fumes, moisture and other destructive agents are present. Details of construction are illustrated.

MOTOR DRIVES—Diamond Chain & Mfg. Co., Indianapolis, has published a 64-page book on stock, chain drives. Tables and instructions are given in the catalog together with engineering data and useful applications of the drives described.

SILENT ROLLER CHAIN—Union Chain & Mfg. Co., Sandusky, Ohio, has issued its catalog No. 200. The catalog contains 124 pages and is in the form of a treatise on modern, high-speed, power transmission of the roller chain type with engineering data and tables. The engineering information is assembled to be of especial value to all who design and install high-speed drives. The second section describes the products made by the company.

AJAX

1880 1930

TRADE MARK

FIFTEEN STANDARDS
For Copper-Base Alloy Ingots

have been adopted by The American Society for Testing Materials under Tentative Specifications.

These specifications cover alloys for castings to meet practically every service requirement, other than so-called high-strength bronzes.

We have adopted these specifications to govern our own production. The distinctive "Ajax Process" will be used in the manufacture of alloys to these new specifications, as well as for all others.

We shall continue also the manufacture of Ajax high-strength alloys, as heretofore.

All Ajax Ingots will be furnished to a quality standard designated as "Seven Point."

Send for our New Booklet,
entitled:
"SEVEN POINT INGOT"

AJAX PROCESS INGOTS

THE AJAX METAL COMPANY
Established 1880
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New York
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Cleveland
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AJAX

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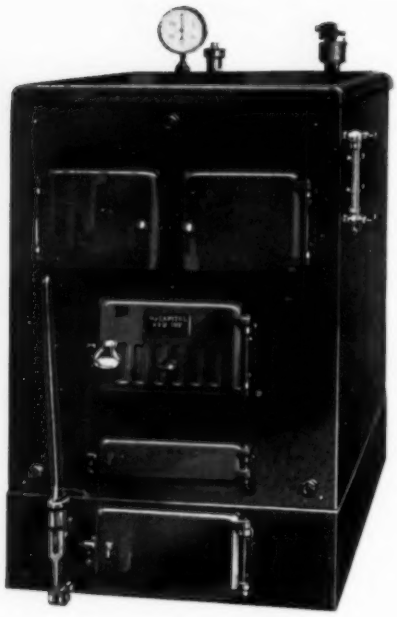
UNITED STATES R
Manufacturers of Capito Boi



CAPITOL
RED TOP
BOILERS

Made with
The Logical Oil
for Cores

Boiler Sections
and
Boiler Section Core

THE WERNER G. S

RADIATOR CORPORATION
Boilers and Radiators

A
16-Year
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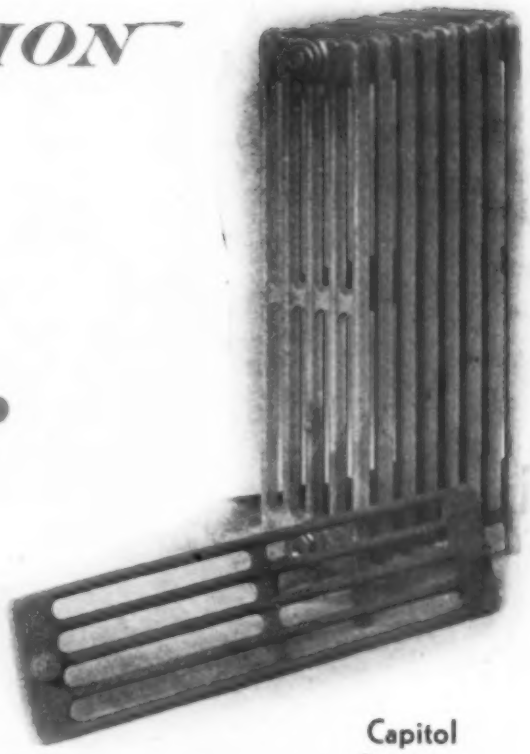


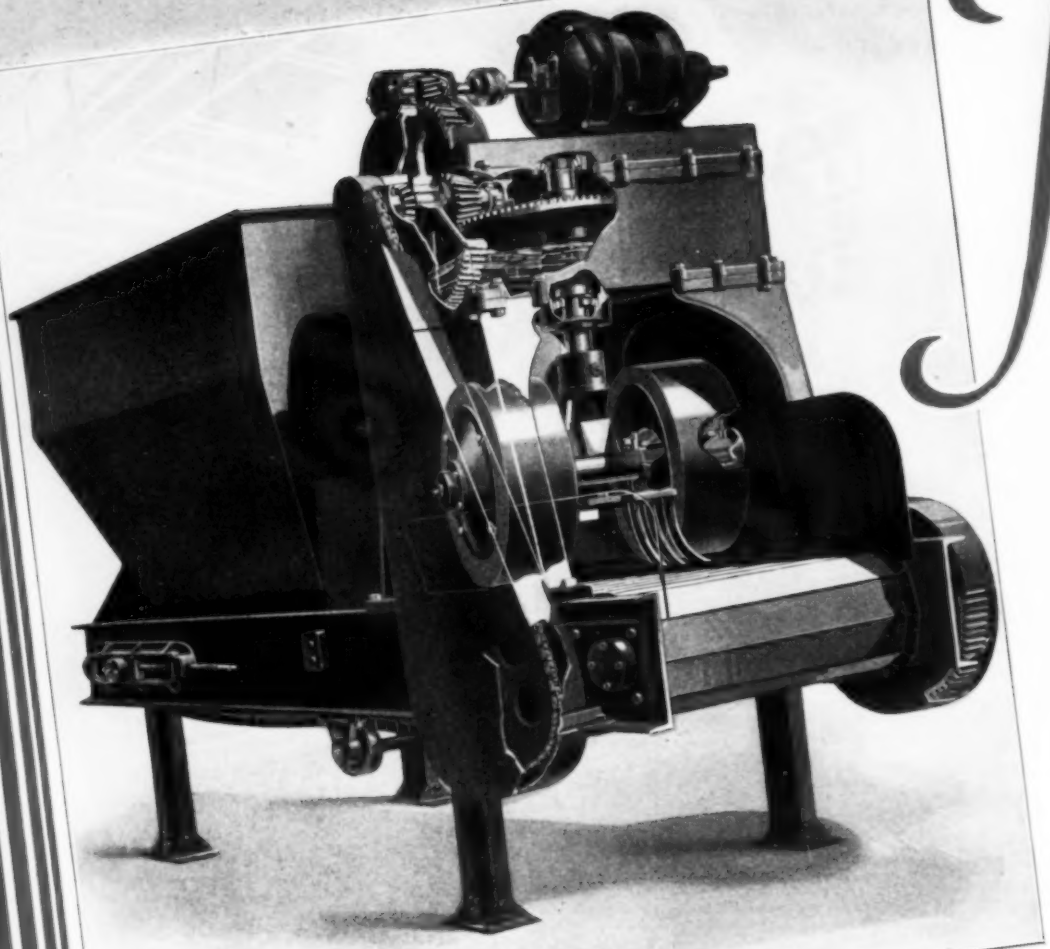
Capitol
Radiator
and Core

THE LOGICAL OIL FOR CORES

There are many good foundrymen in America who regard Linoil as the logical oil for cores and would use none other. These men know from long experience that Linoil is absolutely dependable, that it is uniform to the "nth degree," that it has great strength, and all the other characteristics so essential to profitable founding. A minimum quantity of Linoil binds a maximum quantity of sand, it does not gum on the bench or stick in the core boxes; it bakes quickly and evenly, giving a good porous core which vents freely, with very little gas; it seldom loses a casting and makes cleaning a simple operation. Linoil is a pleasant, satisfactory oil to work with and means real economy and more profits for everybody. Linoil is the logical oil for your cores.

SMITH COMPANY

The



The Beardsley & Piper *Sandmuller* is the last word in mulling equipment — applying the old proved principles of mulling in a modern, continuous, automatic machine. High capacity, trouble-free operation, and more thorough mulling are featured. It is made in sizes of 20 to 80-ton hourly capacity — and in larger sizes where conditions warrant.

Here's what one user says, " . . . the Beardsley & Piper *Sandmuller* has given very satisfactory results. In fact, the operation of this machine has more than come up to our expectations and we have accomplished the improvement in our sand condition which we had hoped for . . . we are entirely satisfied with the *Sandmuller*." (name of user on request)

IT'S CONTINUOUS

SANDMULLER

ANOTHER BEARDSLEY & PIPER ACHIEVEMENT!

Beardsley & Piper Engineers, after many months of development and test, present here a new high capacity, automatic, continuous sand mulling machine—the *Sandmuller*.

This new adaptation of the old mulling principles is saving of labor because it is automatic and continuous, and can be tied into any sand handling system regardless of size or the amount of conditioned sand required.

Ruggedness is inbuilt — moving parts are Timken bearinged — main drive gears operate in an oil bath — muller wheels are rubber tired to eliminate skidding, improper mulling and to insure long life — apron conveyor is provided with easily renewable wearing plates — and only one 15 H.P. motor is required for driving muller and conveyor.

The *Sandmuller* is made in single and twin units with a capacity of 20 to 40 — and 80 tons per hour respectively. Both types of units have been shop and field tested, and have proved 100 per cent satisfactory to users.

Like *Sandslingers, Sandmullers* are machines that are way ahead of the times.

Foundrymen everywhere are invited to investigate this new machine — send for descriptive literature — write for comments of users and see the single and twin installations in operation.

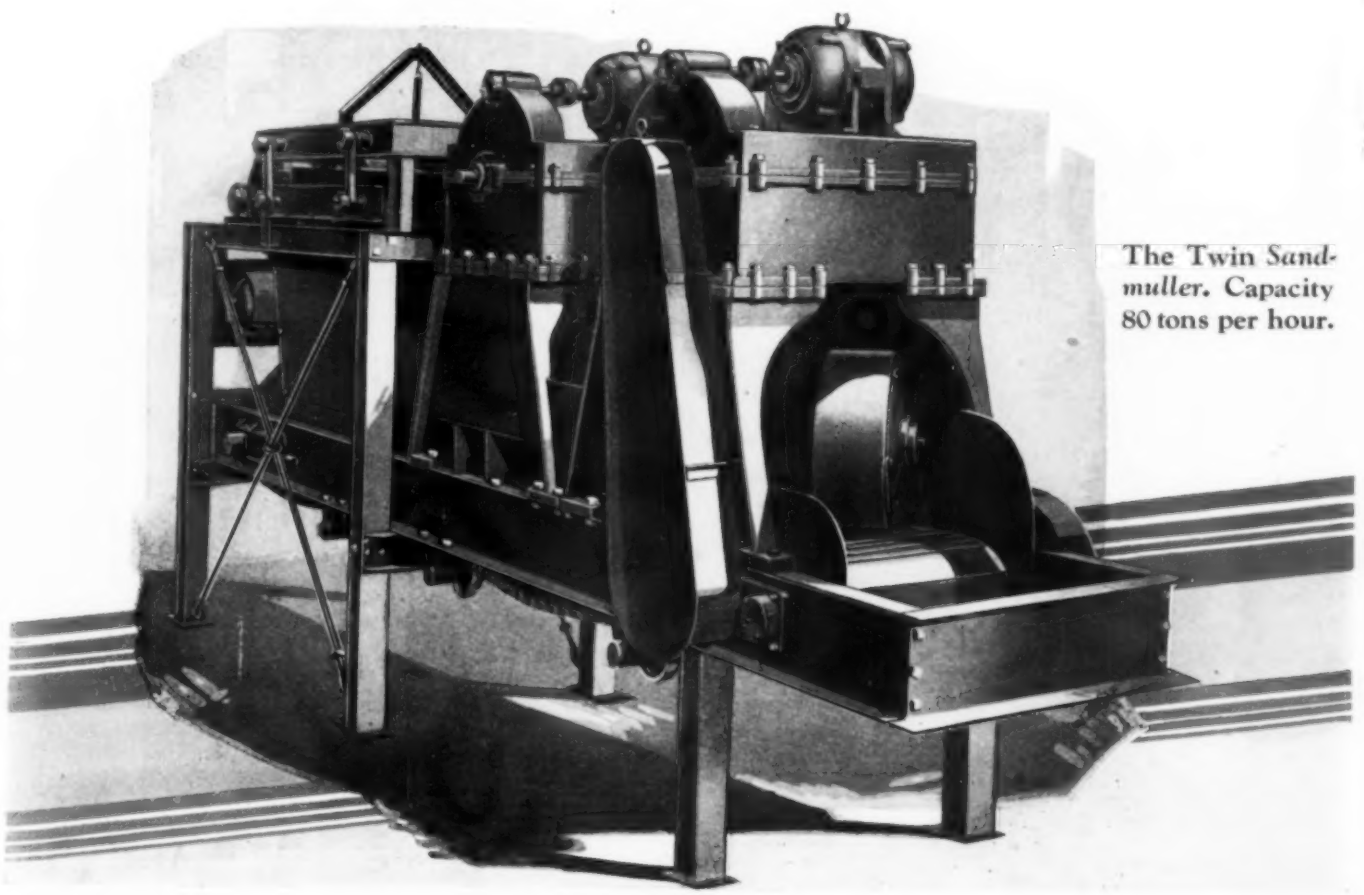
See the *Sandmuller* before you buy mulling or mixing equipment of any kind!

THE BEARDSLEY & PIPER COMPANY

Sand Conditioning, Conveying and Molding Equipment

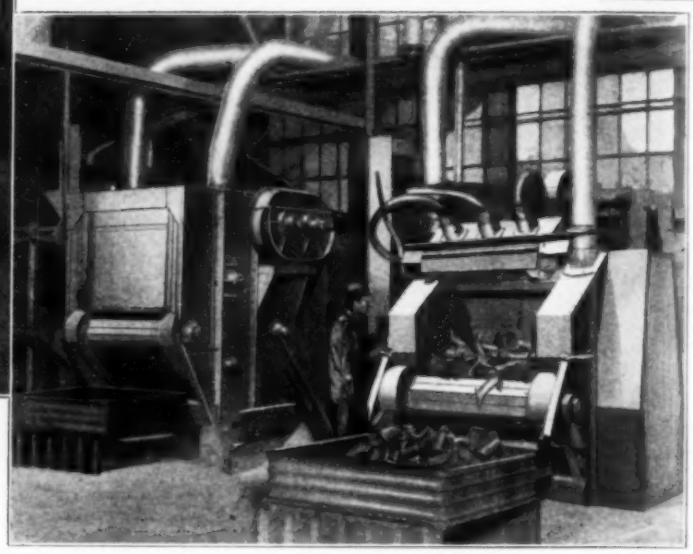
2541 NORTH KEELER AVENUE, CHICAGO, ILLINOIS

Representatives in Principal Foreign Countries

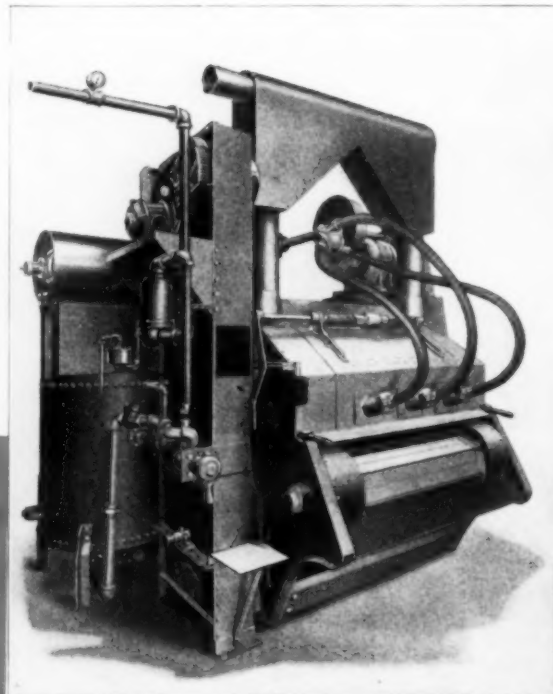


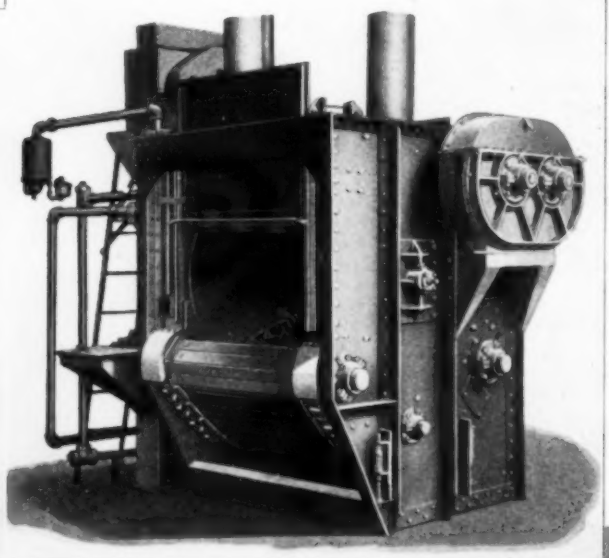
The Twin *Sandmuller*. Capacity 80 tons per hour.

FOR THE



Two Tum-Blast installations where considerable additional cleaning capacity was obtained at an even lower cost. Names and facts on request.





The standard No. 200 Tum-Blast is ideally suited for small to medium sized work and the No. 48 Tum-Blast for large work or greater capacity on small work. These units will clean a wide range of casting sizes and shapes *better, quicker and at lower cost.*

FIRST TIME IN SAND BLAST HISTORY —

Large Capacity, High Speed Cleaning, Perfect Finish, and low operating and maintenance costs are possible in one Sand Blast Machine — The American Tum-Blast Cleaner!

In one or all of these exclusive advantages the American Tum-Blast Cleaner has no equal!

Figured in terms of single castings or weight per load, in minutes of cleaning time, quality of finish, reduction in breakage, elimination of tangling or in minutes or years of operation, the Tum-Blast capacity exceeds by wide margins that of all types of sand blast mills or barrels.

Authentic facts and figures are available and we would appreciate the opportunity of spreading them before you if there is any doubt in your mind of Tum-Blast supremacy.

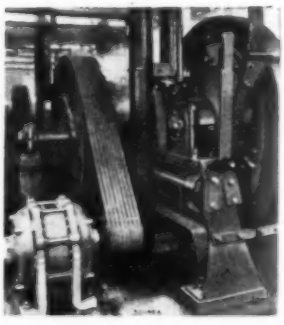
THE
AMERICAN
FOUNDRY EQUIPMENT CO.
MISHAWAKA, INDIANA

American Radiator Co. is equipping to meet 1931 conditions with *better* production at *lower* costs . . . "Tests indicate your new mills are efficient and durable; we like them", says a recent letter.

"We like them" says AMERICAN RADIATOR

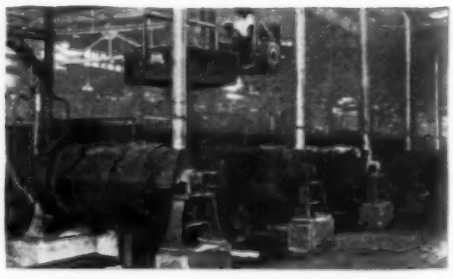
FIVE modern Roller Bearing Tumbling Mills, just installed by Sly at the great American Radiator malleable iron plant in Buffalo, are ready for 1931 production needs. Based on thorough working tests, "We like them", says the experienced executive who will be responsible for the tonnage cleaned.

For every tumbling job, Sly's new Roller Bearing Mill means new economy and new production speed. Roller bearings throughout; full pressure lubrication, completely dust-proofed; new quick-acting positive door lock; new Venturi type ventilation; interchangeable parts. Photographs show malleable fittings loading into mill from overhead bucket (above); battery of five mills, traveling crane (below); detail of drive and main trunion bearings (right). Send for complete information on this *modern* Tumbling Mill!



THE W. W. SLY MANUFACTURING CO.
4702 TRAIN AVENUE CLEVELAND, OHIO

SLY TUMBLING MILLS



Clean! Fast! Finish!

Like the diamonds from which we take the brand name, Diamond Sand Blast Sand is clean, sharp, fast cutting. Ideal for all manner of sand blasting, being especially prepared for this kind of work.

DIAMOND leads all other abrasives in QUALITY. It cleans faster, gives a finish to the work impossible to duplicate with other forms of abrasives, and is the most economical cleaning agency possible to procure.

ACCEPT NO SUBSTITUTE FOR THIS CLEAN, HARD, FAST WORKING, LONG WEARING, ECONOMICAL ABRASIVE. And in addition to abundant raw materials and resources, WE HAVE THREE MILLS TO SERVE YOU, situated on two great trunk line railroads. We are prepared to serve you promptly and efficiently.

Make use of our engineering service, without obligation. Call on us to assist you in solving your sand blast problems.

Shipped Bone Dry in Paper Lined Box Cars, Winter or Summer

SEND FOR OUR BOOKLET "Sandblasting Up To Date"

Ottawa Silica Co., Ottawa, Ill.

Put These In A Safe Place

Faulty gating is responsible for 20 per cent of the casting troubles that vex foundrymen. No one knows this fact better than Pat Dwyer, engineering editor of The Foundry. As foundry superintendent, student of casting manufacturing practice, engineering editor and advisor to hundreds of readers of The Foundry, his observation has covered practically every phase of the gating problem.

Starting January 1, 1931 and appearing periodically thereafter, The Foundry presents a series of exceptional articles on gating, by Pat Dwyer. Read them carefully, then file them for permanent reference.

If you see only the plant copy, why not subscribe now for your own copy to be sent to your home? Then you can put these articles in a safe place and have them for future use.

THE FOUNDRY, 1213 W. Third St., Cleveland, Ohio.

Please send THE FOUNDRY to my home for one year starting with the current issue and send the statement to me. Domestic rate $3.00, Canada $4.00 and foreign £1.

Name..... Position.....

Number and Street..... City.....

Employed by..... State.....

Which Core Oil Suits YOUR Needs Best ?

Of all brands and grades, there's just one particular oil that gives best results—providing sharp, strong, perfectly dried cores which produce perfect, easily cleaned castings free from blow holes and other "core imperfections".

Kellogg's fill the bill because the linseed oil base forms the strongest binder, drying quickly, uniformly and completely by chemical action, producing tough cores of highest compression strength, and disintegrating completely under the heat of the metal.

Yet this greater satisfaction costs no more because, in addition to eliminating costly core troubles, they actually go further.

Seven grades—one to suit your individual needs and requirements.

Try them;—just phone the nearest Kellogg Warehouse.

Spencer Kellogg & Sons Sales Corp'n.
Core Oil Department
Buffalo, N. Y.

Kellogg's Core Oils

Warehouse Stocks at Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Detroit, Grand Rapids, Kansas City, Los Angeles, Milwaukee, Minneapolis, New York City, Philadelphia, St. Louis, San Francisco and Springfield, Ohio.

KELLOGG'S THE BEST 1894

FOUNDRY EQUIPMENT

ENGINEERED

FOR LOWEST FOUNDRY COSTS

Let these cost figures testify to the value of modern equipment

"Today our cost per pound for castings is only one-half of what it was ten years ago."

• There's a dollars and cents message in this statement, recently made to us by the manager of a certain large grey iron foundry. No foundry that is still depending on old-fashioned hand methods can afford to overlook the significance of this message.

Wages and material costs have remained at a high level. But modern equipment plus intelligent farsighted management have combined in this foundry, to achieve new standards in the face of these handicaps.

For almost ten years Bartlett and Snow engineers have shared with the management in the responsibility of keeping this foundry as up-to-date . . . as efficient . . . and as economical in operation as modern foundry conveying and handling equipment can make it.

Today the cost per pound for castings is only one-half of what it was ten years ago. Under the old methods of 1920 the man power employed was three times as large, in proportion to output, while the floor area required was five times as great as it is today.

Bartlett and Snow equipment, engineered to increase efficiency and to cut costs, has been a large factor in attaining these results. For Bartlett and Snow engineers take pride in their record for leading the way to new attainments in modern foundry practice. Foundries, both large and small, find that Bartlett and Snow equipment brings new standards of efficiency . . . higher standards of craftsmanship and welcome savings in costs. Write for Bulletin No. 63 which explains the benefits of these methods.

THE C. O. BARTLETT & SNOW COMPANY · 6201 Harvard Avenue · Cleveland, Ohio

FOR THE DOMINION OF CANADA
PEACOCK BROTHERS, LTD., MONTREAL

FOR CONTINENTAL EUROPE
Société Anonyme des Acieries ci-devant Georges Fischer Schaffhouse, Switzerland.

BARTLETT-SNOW

FOR GREAT BRITAIN
PNEULEC, LIMITED, SMETHWICK, NEAR BIRMINGHAM

FOR facing and in cores where green bond is a factor, Mogul has proved exceptionally efficient—distinctly superior in results and much more economical. Cores do not sag or swell—they come clean from core boxes—and have the right porosity for free venting.

Our experienced and practical foundrymen can prove to your satisfaction MOGUL is all we claim for it.

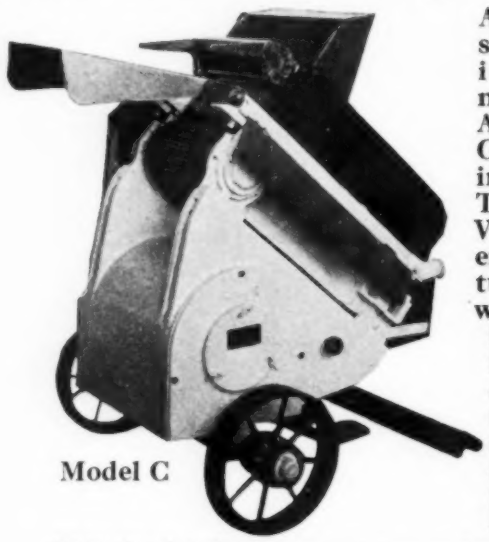
CORN PRODUCTS REFINING CO.
17 Battery Place **New York, N.Y.**

MOGUL
Made by an Original and Unique Process

OVER 1,500 ROYERS IN USE

124 Companies are using 389

Allis-Chalmers Mfg. Company . . 3
Almont Mfg. Company 2
Aluminum Co. of America 5
American Car & Foundry Co. . . . 3
American Radiator Company . . . 23
American Steel Foundries 2
Anthes Foundry Company, Ltd. 2
Babcock-Wilcox & Goldie-McCulloch Company, Ltd. . . 2
Bagley & Sewall Company 3
Baltimore Malleable Iron & Steel Casting Co. 2
Benson Brothers 3
Benton Harbor Malleable Industries 2
Bethlehem Steel Company 5
Bohn Aluminum & Brass Corp. . . 2
Bostick Stove Company 2
Bridgeport Malleable Iron Works 2
Buffalo Bronze Die Casting Corp. 2
Buffalo Foundry & Machine Co. 2
Bunting Brass & Bronze Company 4
Campbell, Wyant & Cannon Foundry Co. 4
Canada Iron Foundries, Ltd. . . . 2
Canadian Locomotive Co., Ltd. . . 2
Cia. Fundidora de Fierro y Acero de Monterrey, S. A. 2
J. I. Case Company 2
Cincinnati Milling Machine Co. 4
Connecticut Foundry Company 2
Cooper-Bessemer Corp. 2
Covel Mfg. Company 5
Crane Company 8
Darling Valve & Mfg. Company . . 2
Dayton Malleable Iron Company 3
G. Dikkers Company 2
Duriron Company, Inc. 2
Electric Auto-Lite Company 2
Fairbanks Morse & Co., Inc. . . . 2
Ferro Machine & Foundry Co. . . 4
Stanley G. Flagg & Company . . . 2
Florence Pipe Fdry. & Machine Company 2
Foran Foundry & Mfg. Company 3
France Foundry & Machine Co. 2
Fremont Foundry Company 3
Frontier Iron Works 7
Fuller-Lehigh Company 2
Fulton Sylphon Company 2
Gartland Haswell & Rentschler Fdry. Co. 2
Gartland-Toledo Foundry Co. . . . 2
Gem City Stove Company 3
General Alloys Company 2
General Electric Company 15
General Fire Extinguisher Co. . . 3
General Railway Signal Company 2
Gleason Works 2
Goulds Pumps, Inc. 2
Griffin Wheel Co. 2
H. & B. American Machine Co. . 2
Wm. A. Hardy & Sons Company . 2
Harris-Seybold-Potter Company, Seybold Mach. Div. 2
Hersey Mfg. Company 2
Howard Foundry Company 2
Howe Scale Company 2
Hubbard Steel Foundry Company 2
Hunt-Spiller Mfg. Co. 2
Ingersoll-Rand Company 5
International Harvester Co. 2
International Heater Corp. 2
Jenkins Brothers 7
Kohler Company 2
Kuebler Foundries, Inc. 3



Model C

A SURVEY of several Royer installations made by the A. C. Nielsen Co., will be of interest to you. These SURVEYS cover every phase of actual operation, with facts, and figures, on performance, costs, and show *savings as high as $3,869.00 per year with one Royer.*

Write for detailed Nielsen surveys and New Catalog.

The ROYER

A Great Cost-Cutter

Kuhns Bros. Company 2
Landis Machine Company 2
Lavelle Foundry Company 2
H. C. Macaulay Foundry Co. . . . 3
Magnus Metal Company, Inc. . . . 4
Manufacturers Foundry Co. 3
Mathews Steel Casting Company 2
Maumee Malleable Castings Co. . 2
Meadows Mfg. Company 2
Mueller Company 3
National Bearing Metals Corp. . . 3
National Lock Company 2
National Malleable & Steel Castings Co. 2
National Pressure Cooker Co. . . . 2
National Radiator Company 4
National Tube Company 3
New Haven Foundry Company . . 3
North Jersey Foundry Company 2
Oakland Foundry Company 2
M. L. Oberdorfer Brass Company 3
Otis Elevator Company 5
Perfect Circle Company 4
Piston Ring Company 3
Pittsburgh Plate Glass Company 3
Pittsburgh Valve Fdry. & Construction Company 2
Plainville Casting Company 3
Pratt & Letchworth Company . . . 2
Prescott Company 2
Railway & Power Engineering Company 2
Reading Steel Casting Co., Pratt & Cady Div. 4
Reed-Prentice Company 2
Richardson & Boynton Company 4
Richmond Radiator Company . . . 2
Saco-Lowell Shops 9
Semi-Steel Casting Company 2
H. B. Smith Company 3
Standard Foundry Company, Buffalo, N. Y. 3
Standard Foundry Company, Worcester, Mass. 2
Standard Stoker Company 2
Stockham Pipe & Fittings Co. . . . 2
Symington Company 2
Superior Engine Company 2
Treadwell Engineering Company 3
United Shoe Machinery Company 2
U. S. Aluminum Company 3
U. S. Navy Yards 6
Wagner Mfg. Company 3
Walker Metal Products Co., Ltd. 2
Walworth Company 2
Warren Foundry & Pipe Co. 3
Western Foundry Company 3
Whitehead & Kales Company . . . 2
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Worthington Pump & Machinery Corp. 3
Wright Aeronautical Corp. 6
Yale & Towne Mfg. Company 2

ROYER FOUNDRY & MACHINE CO.

KINGSTON STATION — WILKES-BARRE, PA.

ROYER PRODUCTS RECOMMEND THEMSELVES

REPRESENTATIVES:

BOSTON, MASS.
Alexander Haigh

DAYTON, OHIO
Fenton Foundry Supply Co.

BIRMINGHAM, ALA.
Hill & Griffith Co.

OAKLAND, CALIF.
Pacific Graphite Works

ROCHESTER, N. Y.
David D. Baxter

CHICAGO, ILL.
Page Sales Service
407 So. Dearborn St.

LOS ANGELES, CALIF.
Snyder Foundry Supply Co.

SEATTLE, WASH.
Western Foundry Sand Co.

Distributed in Canada by Canadian Foundry Supplies & Equipment, Ltd., Montreal, Que. and Toronto, Ont.
Manufactured in Great Britain by Pneulec, Ltd., Smethwick, near Birmingham.
Manufactured in France by Fenwick Freres, 8 Rue de Rocroy, Paris

When the going is HEAVY

--- try Rosinal! ROSIN IN SOLUTION

WHEN the business track slows up the race, when the going is heavy and everyone is fighting for the rail—try Rosinal.

It will reduce your cost-per-pound of finished castings by reducing core breakage, cleaning time and—in many cases—the actual cost per core for binder . . . When you need every advantage in the business race, when profits are made from careful management rather than volume, test Rosinal—the basic core binder material to which you add linseed or any other drying oil to suit your requirements.

The largest foundries in the country have standardized on Rosinal. It will prove its economy on your work too.

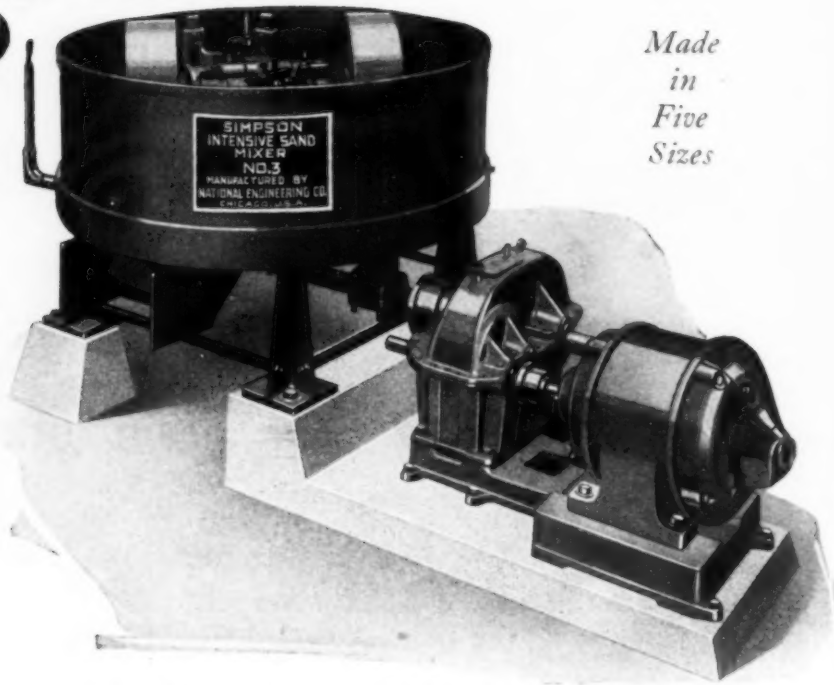
Delco REG. U.S. PAT. OFF.

INDUSTRIAL OIL-PRODUCTS

LINDSAY-McMILLAN CO. MFGRS.
MILWAUKEE WISCONSIN
Plants: Savannah-Milwaukee

Saving $3000 a year

One Only No. 3



Made in Five Sizes

"The Product of a Practical Foundryman"

SIMPSON Intensive Sand Mixer

operated by one man, is capable of effecting the above saving in your foundry, due to reduction of new sand or binder required, reduction of cleaning costs, elimination of defects due to sand condition, and reclaiming of waste sands thru the use of this machine.

Especially at this time, when even small economies are so imperative, it will pay you to investigate the Simpson Mixer with us.

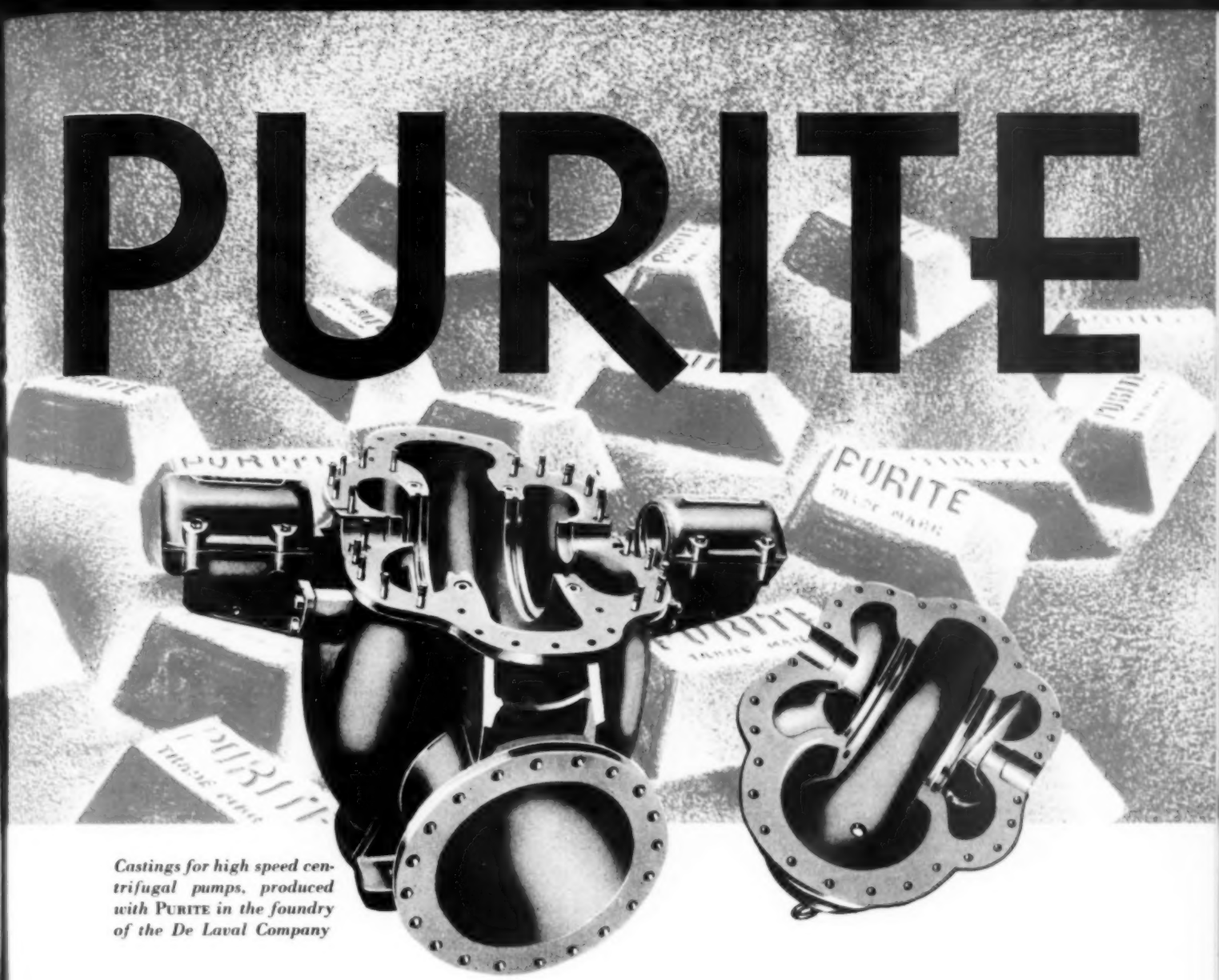
Install Now—*On the deferred payment basis, if desired*

NATIONAL ENGINEERING COMPANY

MACHINERY HALL BUILDING 549 W. WASHINGTON BLVD.

CHICAGO, ILL., U. S. A.

PURITE



Castings for high speed centrifugal pumps, produced with PURITE *in the foundry of the De Laval Company*

...the modern flux...
for better melting and cleaner iron

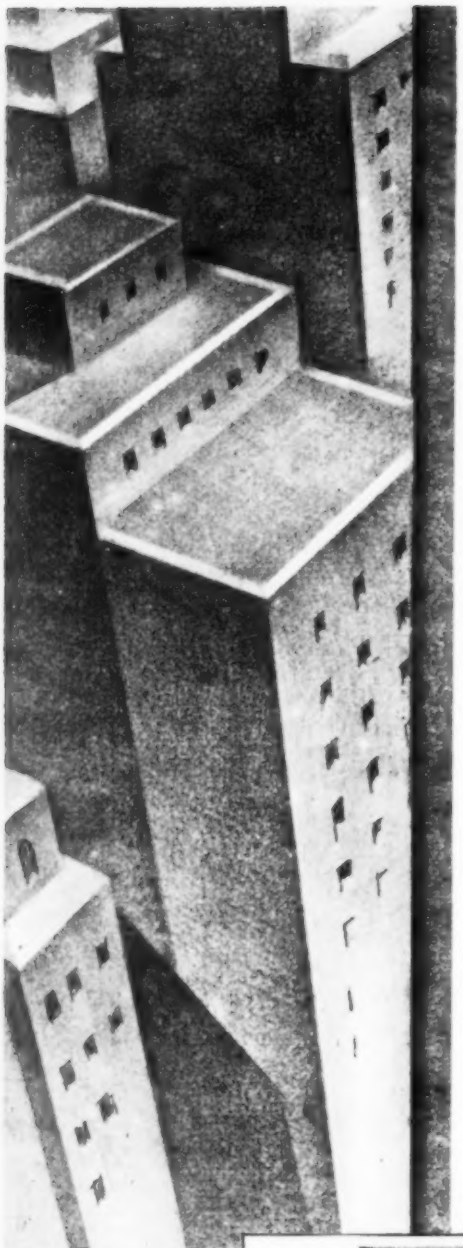
WHEN used at the start, PURITE melts right after the blast goes on. It softens up the limestone and gives a quick, highly basic, fluid slag which flushes off the ashes and insures hot melting from the start—the surest way to secure good iron throughout the heat.

Fluxing with PURITE makes ALL iron better—pig iron or all-scrap mixtures—it cleans out entrained oxide—slag inclusions and reduces sulphur. In leading foundries everywhere...in castings weighing from a few ounces to many tons...PURITE is reducing losses, keeping costs down, insuring sounder castings, reducing internal strains, improving machining quality.

PURITE—the modern basic flux—commands a prominent place in present-day foundry practice. Write for a list of available bulletins.

THE MATHIESON ALKALI WORKS (Inc.), 250 Park Avenue, New York City

PURITE A MATHIESON PRODUCT



A Structure can be no stronger than its FOUNDATIONS

By CARL R. MILLER

No. 6 in a series of advertisements describing the position of The Mathieson Alkali Works in the chemical industry

WHERE plodding oxen once came for a cart of precious salt...today a modern Mathieson plant produces tons of useful chemicals needed for Industry's mills and factories. Near mighty Niagara, unharnessed for ages...today a Mathieson plant extracts power from the falls and elements from air and minerals, transforming them into chemical products that protect the lives of millions...products which cost no more yet serve better.

These modern miracles would have been impossible without strong foundations of Resources, Research and Service...foundations laid in the pioneer days of the chemical industry. That is why Mathieson chemicals represent quality born of seasoned experience...that is also why Mathieson service assures satisfaction to every purchaser.

A list of available literature describing the many uses of Mathieson chemicals will be sent on request.

The MATHIESON ALKALI WORKS *(Inc.)*

250 PARK AVENUE NEW YORK, N. Y.

PHILADELPHIA CHICAGO PROVIDENCE CHARLOTTE CINCINNATI

Works: Niagara Falls, N. Y.– Saltville, Va.

Warehouse Stocks at all Distributing Centers

Soda Ash...Caustic Soda...Bicarbonate of Soda...Liquid Chlorine...HTH (Hypochlorite)...Ammonia, Anhydrous and Aqua...Bleaching Powder...Sulphur Dichloride...PURITE (Fused Soda Ash)

MATHIESON CHEMICALS

MATHIESON CHEMICALS

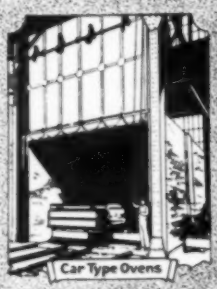
SERVICE

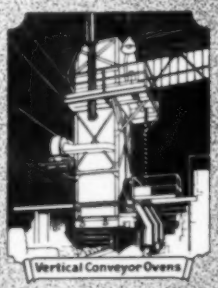
RESOURCES | RESEARCH

Great Structures Rest on Strong Foundations

PRINTED IN U.S.A.

26 years of Leadership





Showing part of over one hundred Coleman "Transrack" Ovens installed at foundries of General Motors Corporation.

Core Handling Costs Reduced with Coleman "Transrack" Core Ovens

The portable rack system of core oven operation eliminates indirect labor and reduces handling costs to a minimum. Coremakers' time is all spent in making cores and none of it carrying them.

Racks loaded with green cores are transported by lift truck to the ovens. Empty racks are immediately available to the coremakers for loading. Baked racks are quickly replaced with green racks, affording rapid turn-over and maximum use of oven capacity.

The patented Coleman heating system assures *fast and uniform baking* and efficiently uses any fuel—coke, oil, gas, electricity, etc.

Coleman "Transrack" Core Ovens are in successful use in hundreds of foundries, from the largest production shops to the small jobbing and specialty foundries.

Write for Complete Catalog F

The FOUNDRY EQUIPMENT Co.

Builders of Coleman and Swartwout Ovens
Contracting Engineers and Manufacturers
CLEVELAND, OHIO

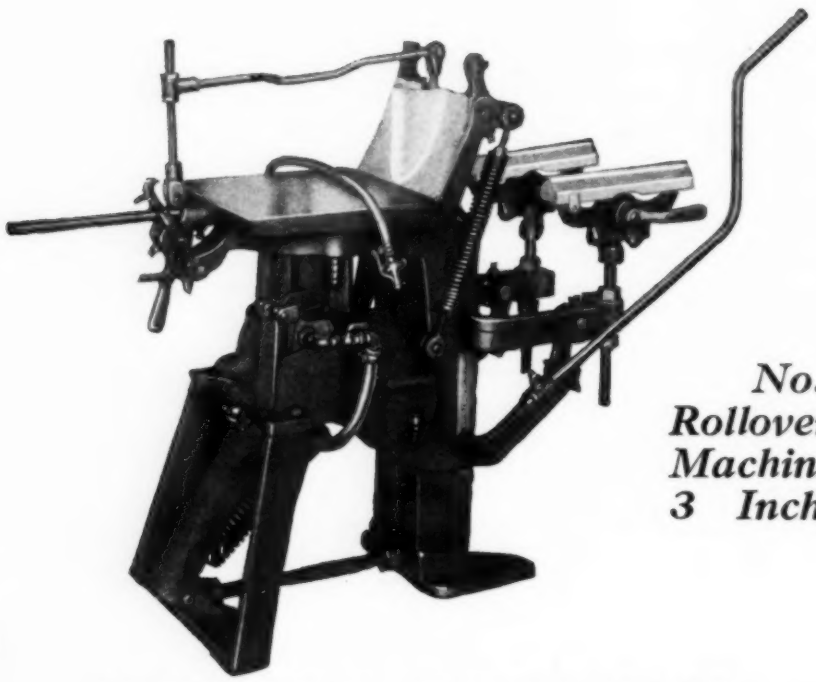
3024

COLEMAN CORE & MOLD OVENS

Swartwout Ovens

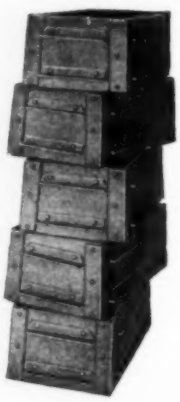
ARCADE MOLDING MACHINES AND FOUNDRY EQUIPMENT

Core Machines

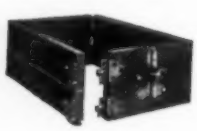


No. 4 Rollover Core Machine with 3 Inch Jolt

Steel Jackets
No. 10 Gauge
WELL BRACED



Cherry Flasks
MILLED PINS
AND EARS



THE Jolt Pattern Table and Roll-over Frame are now cast in one piece (Steel) eliminating the inherent faults of a separate table which had to be locked to the frame for rolling over.

Makes cores more uniform than hand jolting. Accurate draw. Fast and reliable.

No. 2 Roll-over (hand jolt)

See Bulletin 31-K2.

Arcade Manufacturing Company Freeport, Illinois U. S. A.

*9

Now let us see about this cost of venting with BUFFALO BRAND Vent Wax

Of course it must be entered on the books as "core-room expense"—BUT that expense is in reality a most profitable investment BECAUSE it's negligible in comparison with the tremendous saving which results from the use of BUFFALO BRAND Vent Wax. Core blowing is ended and the number of defective castings is sharply reduced.

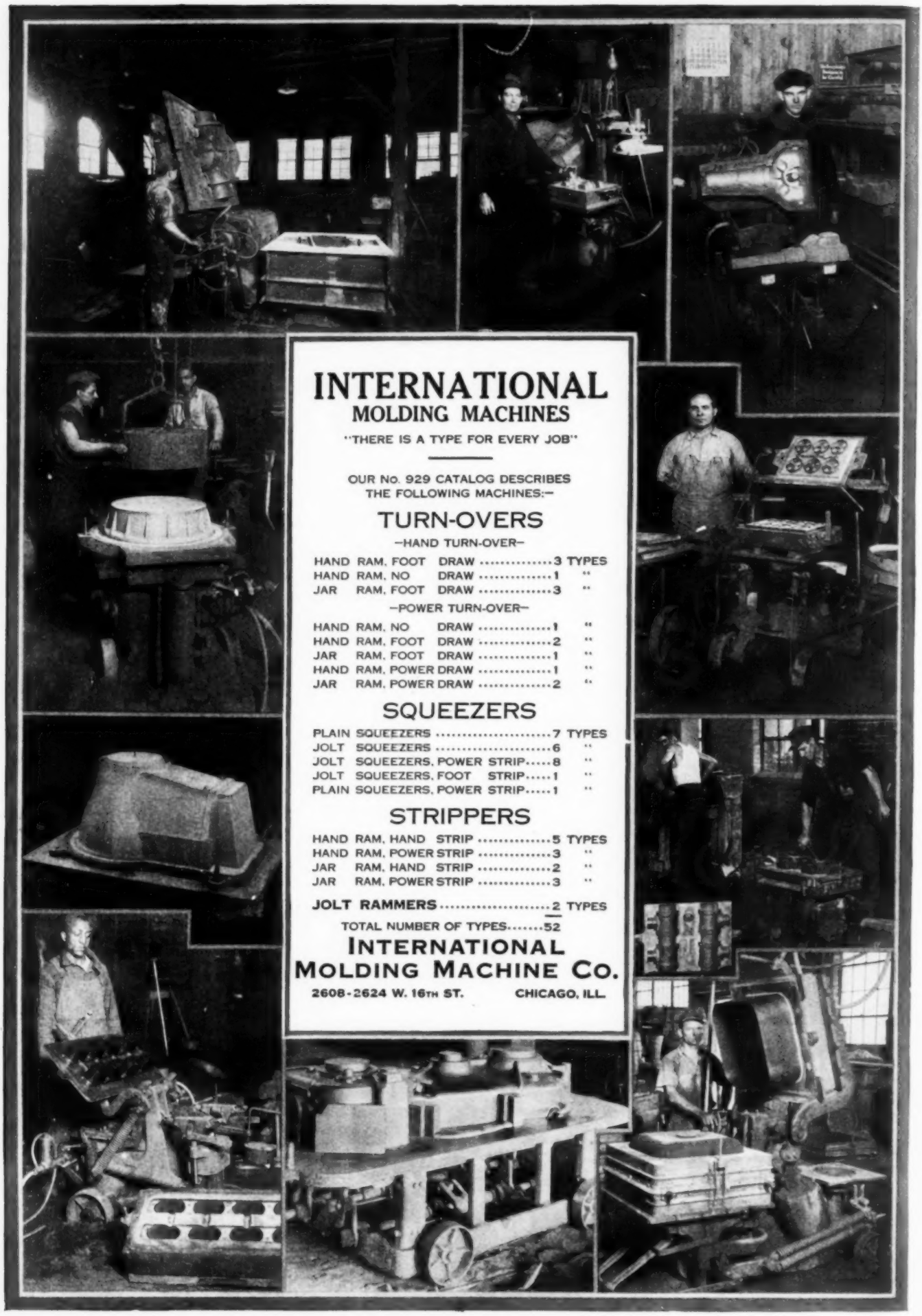
Don't wait until your core-room gets stuck on a venting problem to call for BUFFALO BRAND—and then use just a small length to connect up a couple of rods, etc., to vent some particularly hard corner to reach. There's no money saved that way.

Let it go along with the job right from the drawing-board, through the pattern-shop to the core-room. Cores don't have to be cut-up because of the venting problem, castings can be made in larger units. Much pasting of cores, plugging of rod holes, etc., can be done away with.

You will be surprised at the savings you can make by using more BUFFALO BRAND Vent Wax. Let us talk it over with You.

UNITED COMPOUND COMPANY
BUFFALO, N. Y., U. S. A.

BUFFALO BRAND VENT WAX



INTERNATIONAL
MOLDING MACHINES

"THERE IS A TYPE FOR EVERY JOB"

OUR No. 929 CATALOG DESCRIBES
THE FOLLOWING MACHINES:—

TURN-OVERS

—HAND TURN-OVER—

HAND	RAM, FOOT	DRAW 3	TYPES
HAND	RAM, NO	DRAW 1	"
JAR	RAM, FOOT	DRAW 3	"

—POWER TURN-OVER—

HAND	RAM, NO	DRAW 1	"
HAND	RAM, FOOT	DRAW 2	"
JAR	RAM, FOOT	DRAW 1	"
HAND	RAM, POWER	DRAW 1	"
JAR	RAM, POWER	DRAW 2	"

SQUEEZERS

PLAIN	SQUEEZERS 7	TYPES
JOLT	SQUEEZERS 6	"
JOLT	SQUEEZERS, POWER STRIP 8	"
JOLT	SQUEEZERS, FOOT STRIP 1	"
PLAIN	SQUEEZERS, POWER STRIP 1	"

STRIPPERS

HAND	RAM, HAND	STRIP 5	TYPES
HAND	RAM, POWER	STRIP 3	"
JAR	RAM, HAND	STRIP 2	"
JAR	RAM, POWER	STRIP 3	"

JOLT RAMMERS ..... 2 TYPES

TOTAL NUMBER OF TYPES 52

INTERNATIONAL MOLDING MACHINE CO.

2608-2624 W. 16TH ST. CHICAGO, ILL.

THE MANUFACTURE OF CORN FLOUR CORE BINDER IS A SPECIALIZED BUSINESS

IT requires a thorough knowledge of sands and a practical understanding of core room needs to produce a core binder to properly function in the various foundry practices.

For several years

K-B

Core Binder and Facing Flour

has been one of the accepted standards in steel, grey iron and malleable practices and enjoys a well merited reputation for uniformity in quality. It is available in any quantity required under a quick delivery service.

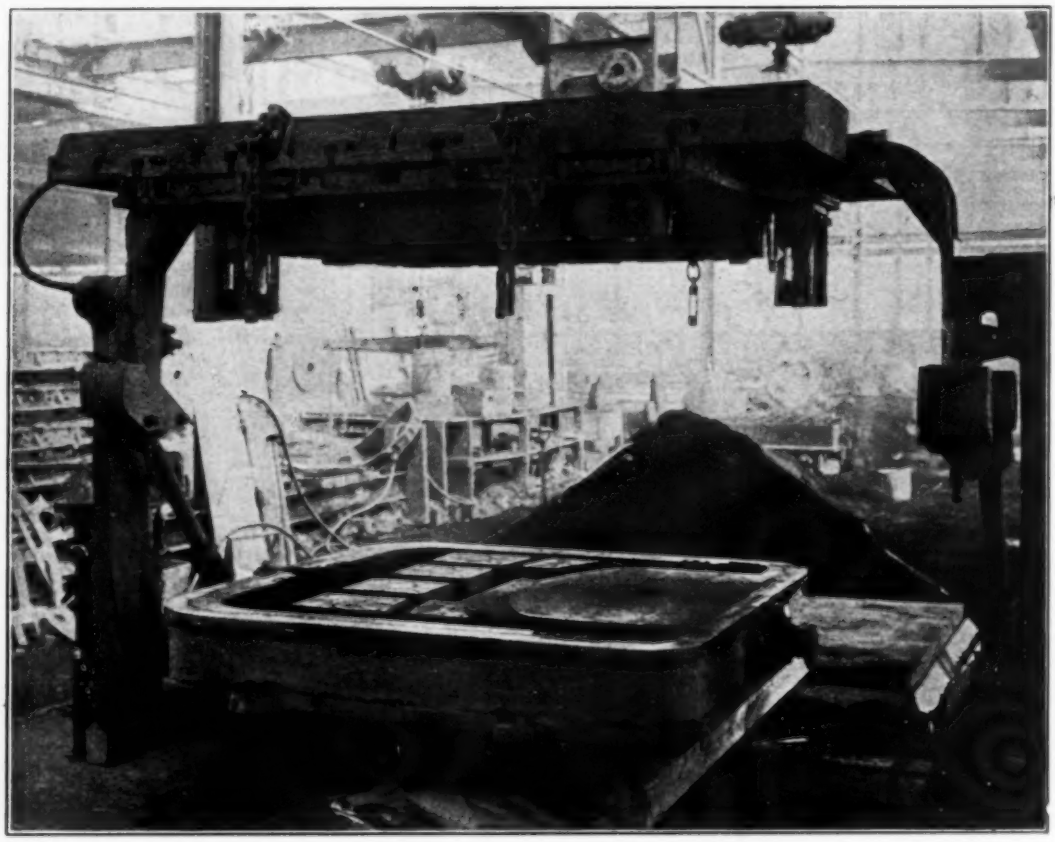
IT COSTS NO MORE.

Knefler-Bates Company
Indianapolis, Ind.

Distributing Warehouses located in all principal American Cities

Agents for Great Britain: Yorkshire Amalgamated Products, Ltd., 27 Waterdale, Doncaster, England

If It's A Herman It's Worth Using. It Made Its Way by the Way it's Made

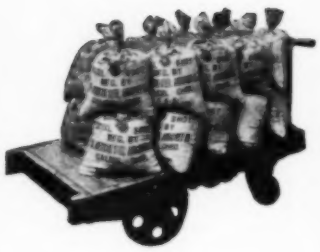


Boiler Section Work made on Herman Machines

Herman Jar Independent Rollover and Pattern Drawing Machines put *speed and efficiency* into such work as boiler sections, engine beds, cast iron columns, machine tool frames, cylinders, and all other work of medium or larger nature. *Ask users—they'll convince you.*

May we have your inquiry? Our Service Department will gladly advise you on your molding machine requirements for such work. This service is free of cost or obligation.

Herman Pneumatic Machine Company
GENERAL OFFICES: Union Bank Building PITTSBURGH, PA.
MANUFACTURING PLANT: ZELIENOPLE, PENNSYLVANIA, U. S. A.
Foreign Works: Pneulec Limited, Mafeking Rd., Smethwick, near Birmingham, England.
Gibson Battle & Co., Limited, Sydney, N. S. W.



Twenty bags of "Eversharp" Steel Grit or "Standardized" Steel Shot will do the work of a carload of sand and do it better.

SWITCH TO STEEL

ZERO WEATHER

Means Less Trouble To Those Who Have Switched to Steel

Your Steel Abrasive is easy to unload and handle.

Your Steel Abrasive is dry, clean, cannot freeze—It's all ready for use.

It's stored inside of course, for it takes so little space. (One cubic foot of American Steel Abrasives will do the work of 100 cubic feet of sand.)

And there's no problem of disposing of spent abrasive either.

The cost with Steel? Much less. The work? Better and faster. Dust from Steel? Almost none.

And you use your regular equipment if in good condition.

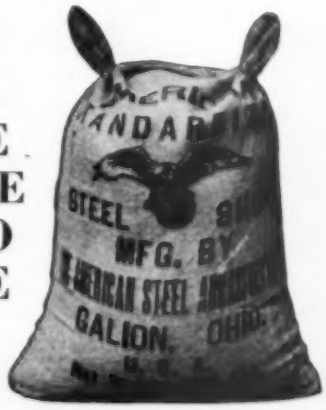
It's never too late to Switch to Steel.

Write us for samples and full information.

THE AMERICAN STEEL ABRASIVES CO.
604 Sherman St. Galion, O.

AMERICAN
STANDARDIZED
STEEL ABRASIVES

THESE 100 LB. DOUBLE BAGS ARE EASY TO HANDLE & STORE



The Titanium Alloy Manufacturing Co.

Niagara Falls, N. Y., U. S. A.

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New York City

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Pittsburgh

Keith Building
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Los Angeles, Portland, Seattle, Tacoma
Vancouver, B. C.

Great Britain & Europe

T. Rowlands & Co., Ltd.—Sheffield, Eng.

Flapper-Valve Hammers chipping steel slugs before final forging operation.

Flapper-Valve Chipper. Made in five sizes for all classes of work.

Winning the O.K. of both men and management

Day Workers like these new Flapper Valve hammers because they make it easier to get the day's work done.

Piece Workers like them because they make it possible to earn more money with no extra effort.

Bosses like them because they stay on the job and cost so little for upkeep. There are no valve maintenance problems with these tools.

INGERSOLL-RAND COMPANY - 11 Broadway - New York City

Branches or distributors in principal cities the world over

For Canada refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

At Right: . . . Valve Seat, Flapper Valve and Valve Box. Note the simplicity of the valve and the short overall length. The valve seat improves with use.

468-PT

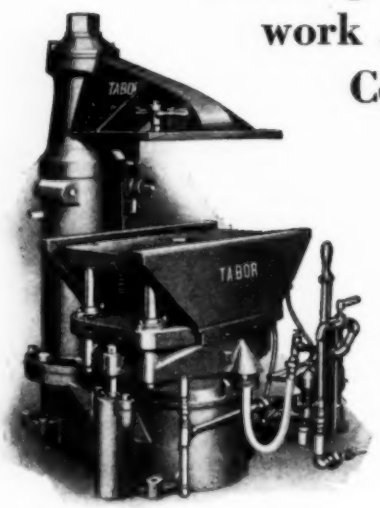
Ingersoll-Rand

Pneumatic Tools

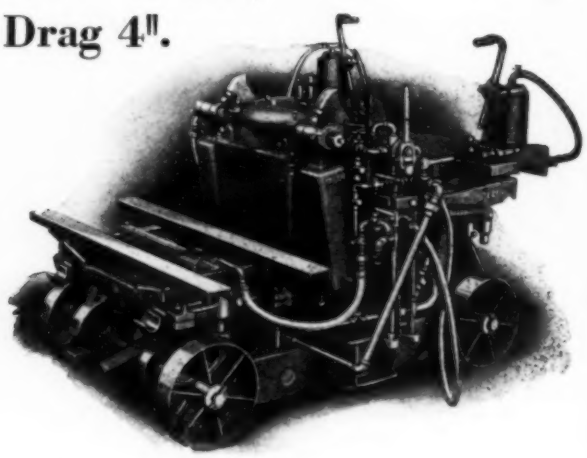
Saved $1300 a year

by using a pair of TABOR machines molding cylinder heads

This saving is particularly significant as the comparison is made with other machine molding equipment on the same work . . Flasks 14" x 38", Cope 6", Drag 4".



TABOR Shockless Jar
Squeeze Flask Lift
Machine (used for Copes)



TABOR Shockless Jar
Rollover Pattern Draw
Machine (used for Drags)

The Tabor Manufacturing Company

6225 TACONY STREET · PHILADELPHIA, PENNA.

Western Representatives:

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Supermal • • • • •

A Superior Metal for Chains and Buckets

Embodying Greater Resistance To Wear, Higher Tensile Strength and Higher Elastic Limits than Heretofore Attained in Malleable Iron

In the field of chain manufacture, Jeffrey has for a half century continued to anticipate industry's requirements. The processing of malleable iron to give it the combined characteristics of extreme hardness and of strength without sacrificing toughness has been a practice with the Jeffrey Company for more than twenty years.

Modern elevating and conveying requirements for metals embodying higher resistance to wear and greater strength have caused our engineers to apply the Jeffrey process for making a greater wear-resisting malleable more generally.

After 5 years of thorough laboratory and field tests, Jeffrey now offers all industries its greatest development in malleable chains and buckets under the registered trade name of "Supermal".

Jeffrey Supermal Chains and Buckets operating under the most severely abrasive conditions have established performance records that surpassed the greatest expectations of Jeffrey Research Engineers.

Important Qualities

Supermal is all that the name implies. It is a metal different from anything now on the market, with a greatly increased resistance to wear over that of malleable iron. It is "FILE HARD" — it cannot be touched on the surface with the flat of a file, yet it retains those desirable qualities of malleable iron — toughness and ductility.

Although, of lesser practical importance, it is interesting to note that Supermal also has a much higher tensile strength and a higher elastic limit than that of average malleable iron.

The qualities of wear resistance, high tensile strength and high elastic limit found in Jeffrey Supermal Chains compare very favorably with those of manganese steel chains, yet the increase in cost is only little more than ordinary malleable chains and substantially less than that of manganese chains.

Although the greatly increased life of Supermal with only a small increase in price over malleable iron more than justifies its use under abrasive or gritty conditions, there are other savings which add to its worth for handling abrasive materials. Fewer replacements mean a smaller labor charge, and less frequent interruptions of operation due to these replacements.

Unusual Qualities Illustrated

The photographs of Supermal buckets, shown at the left, illustrate the two very unusual properties — great wear resistance and ductility — that are so successfully combined in this superior malleable. The "FILE HARD" surface of these buckets does not produce a brittle material even in thin sections. These buckets can be pounded and distorted far beyond any working requirements before breaking.

Another remarkable fact is that these hard buckets can be drilled and punched—see illustration. The three upper holes have been punched; the two lower holes have been drilled. The lower illustration shows a Supermal elevator bucket after it has been pounded out of shape with a 15 pound sledge. Chains and buckets made of Supermal will withstand severe shock and fatigue loads without breaking.

Physical Characteristics Compared

The table below shows some interesting comparisons of Jeffrey Supermal with average malleable iron, soft cast steel annealed and manganese steel.

Name of Material	Yield Point Pounds Per Sq. Inch	Ultimate Strength Pounds Per Sq. Inch	Elongation Per Cent in 2"	Brinell Hardness Number	Scleroscope Hardness
Malleable Iron	*30,000	*50,000	*10.0 Min.	121	25-30
Soft Cast Steel Annealed	30,000	60,000	24.0 Min.	140	25-30
12% Manganese Steel	50,000	85,000 Min.	35.0	200	**35
Supermal	51,000	65,000	8.0	180.200	40.45

* Minimum Standard set by American Society for Testing Materials.
** Heat treated but not cold worked. Cold working increases Scleroscope hardness on the surface to about 70.

Important Uses

Jeffrey Supermal is recommended for conveyors, elevators and chain drives subject to abrasive or gritty condition.

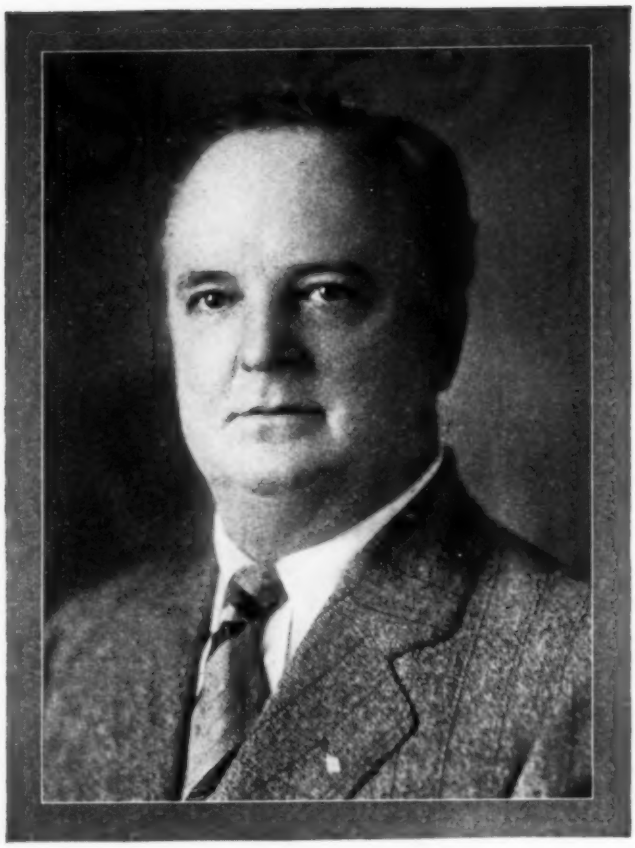
It is also recommended for chain drives where something harder and stronger than standard malleable iron is required to withstand severe usage.

Supermal chains, attachments and buckets can be furnished in all standard sizes. The most popular types and sizes of Jeffrey Supermal Chains and Buckets are listed in Bulletin No. 501, which will be sent to those interested in greater wear resistance combined with toughness and unusual strength in malleable chains and buckets.

THE JEFFREY MANUFACTURING COMPANY
907-99 North Fourth St., Columbus, Ohio
The Jeffrey Mfg. Co., Ltd. of Canada **Main Office: Montreal**

MAGNETIC *Engineering...*

A Review and a Forecast....



Mr. R. H. Stearns has been engaged in magnetic engineering for more than thirty years. He is recognized as an authority in the field and is responsible for many improvements in magnetic equipment. The company of which he is head owes much of its progressiveness to his efforts.

THE past is frequently a prologue to the present; the achievement of yesterday becomes commonplace compared with the accomplishment of today.

Magnetic engineering—the industrial application of electro-magnetism for concentration and purification of materials, protection of process machinery against tramp iron, and for handling services—has attained a degree of development undreamed of ten years ago.

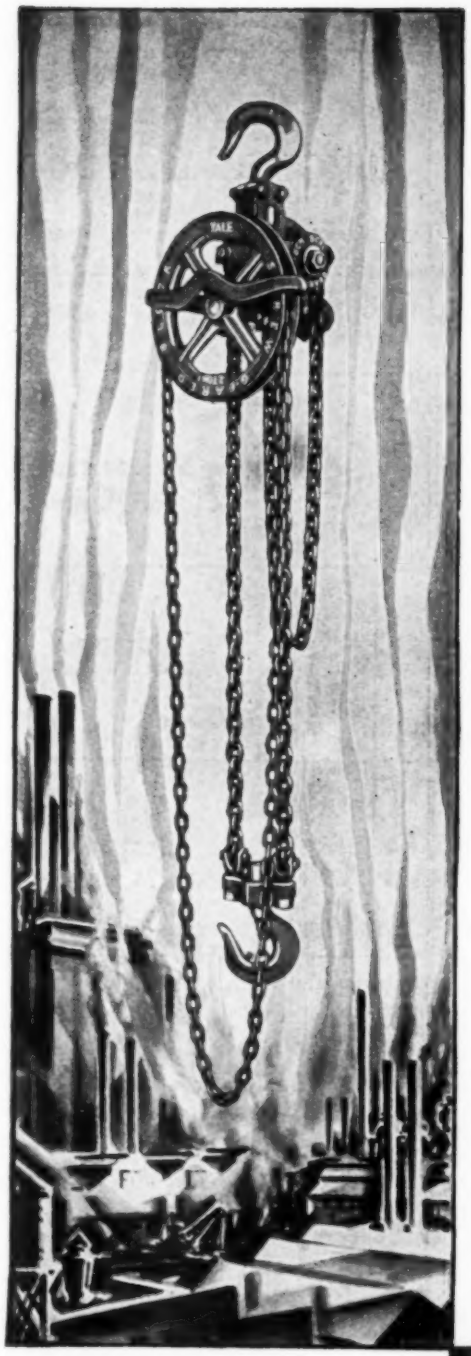
Magnetic machines have been perfected for the separation and purification of materials heretofore unresponsive to magnetic action, such as grains, foodstuffs and other raw materials, as well as ores not previously susceptible to magnetic separation. Magnetized roller conveyors have been developed which possess the unique property of moving iron and steel pipes and sheets up an inclined plane against gravity. Magnetic clutches, although not new to industry, have been brought to a degree of efficiency and range of application unthought of years ago.

Magnetic Manufacturing Company engineers have contributed much to present day utilization of magnetic equipment. They believe that the future will bring advancement in magnetic engineering as absorbingly interesting as that of radio and related sciences. With this in mind they look forward to working with manufacturers and others interested in adapting magnetic equipment to special problems.

MAGNETIC MANUFACTURING CO.
621 S. 28th Street Milwaukee, Wis.

HIGH STEARNS DUTY

MAGNETIC EQUIPMENT



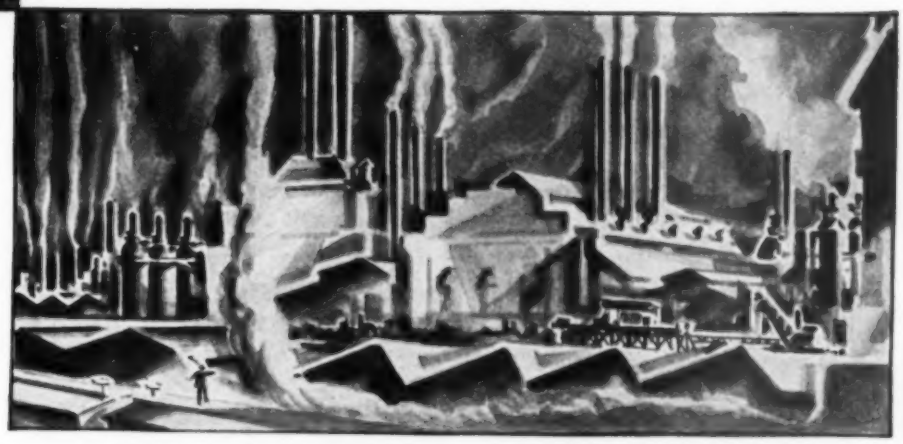
TRADE **YALE** MARK

CHAIN BLOCKS OF QUALITY

Not only SPEED .... but SAFETY

Distributors Serve Industry Economically

THE YALE & TOWNE MFG. CO.
STAMFORD, CONN. U. S. A.
Canadian Works at St. Catharines, Ont.



YALE MARKED IS YALE MADE

Hoisting and Conveying Systems

Every New "Moly" Will Wear *Just Like the Old One*

EXACT Uniformity... that's the reason "Moly" Shovels never disappoint buyers or users. "Molys" are famous for that even hang and balance, wide roomy grip, and comfortable turned over step that makes each a twin to another.

But in the blade and handle—that's where uniformity *really* counts . . . and that's where "Moly" excels.

Wood's engineers spent thousands of dollars and over seven years of scientific experiment and practical testing to develop *molyb*-den-um steel to a hardness and toughness never known before or equaled since. You can't see this quality feature but you'll know it's there when a "Moly" actually outwears 2 to 6 ordinary shovels. A non-uniform "Moly" is so rare that we don't hesitate to replace if one is found.

As to handle uniformity, we'll say just this . . . hundreds of service records show that the chances of a "Moly D" handle breaking in use are less than one in a thousand! Remember that every time you buy or sell a "Moly", there is another one just like it ready to match the satisfaction it's *built* to give.

THE WOOD SHOVEL AND TOOL COMPANY
Piqua, Ohio

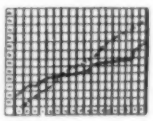
Wood's Shovels

"Moly"—"Big Fist"—"Piqua"

P. S. Wood's "Big Fist" Shovels rank second only to "Moly" in quality and are lower in price.

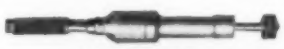
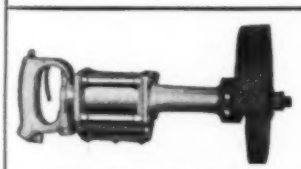
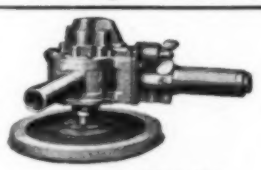
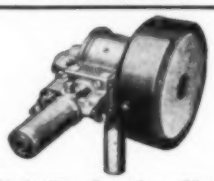
8 Checking Points *for the* Shovel Buyer

Don't take our word for it. Conduct your own comparative tests—bearing in mind these 8 vital points.

1		Hardness and Toughness
2		Balance
3		Grip
4		Step
5		Uniformity
6		Service Record
7		Reliability of Dealer
8		Reputation of Manufacturer

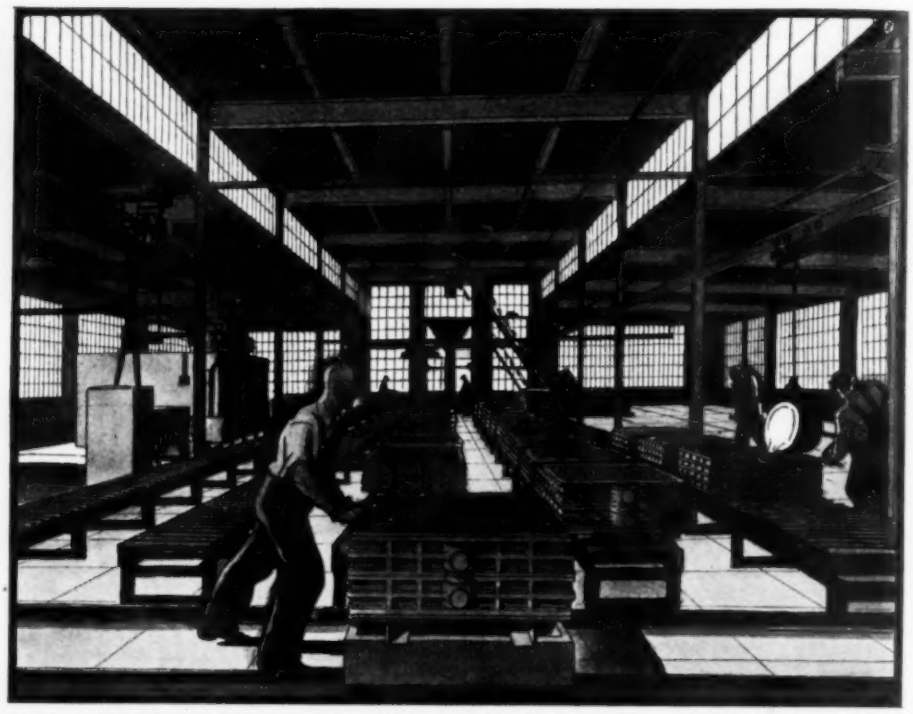
ROTOR AIR GRINDERS

Straight or Spade Handle

Type	Wheel or Brush (Inches)	Free RPM	Full Load RPM	Weight (Pounds)	*The Work It Will Do*
 Die Grinder	1½″ Vitrified 2½″ High Speed	18000 to 20000	13000 to 15000	4	A light, very powerful tool for small grinding wheels, used on dies, metal patterns and similar work.
D-O Grinder Standard and High Production	4″ Vitrified 4″ H S	6000 8000	5500 7200	7 7	For grinding with 4″ wheel, where speed of 6000 or 8000 r.p.m. is wanted. Especially useful for using up stub wheels.
D-1	6 x 1 x ⅝ or 6″ Brush	4300	4000	9¼	For general grinding, wire brushing, and buffing with 6″ wheels, where a working speed of 4000 r.p.m. is desired.
D-1 High Production	6 x 1 x ⅝ or 6″ Brush	6000	5700	9¼	A High Production Model for 6 x 1″ wheels of the high speed type, operating at 5700 r.p.m.
D-1, 13″ Extension D-1, 26″ Extension	6 x 1 x ½ 4 x 1 x ½	4300 10000	4000 6000	11 16	For grinding inner surface of hollow castings which would otherwise be inaccessible. Uses cone wheel, plain wheel or cupped wheel of small diameter. Straight handle only.
D-3	8 x 1 x ⅝ or 8″ Brush	3200	3000	16	For general grinding, wire brushing and buffing with 8″ wheels where working speed of 3,000 r.p.m. is desired.
 D-3 High Production	8 x 1 x ⅝ or 8″ Brush	4500	4300	16	For use with 8 x 1″ High Speed Rubber, Bakelite and Elastic Bonded Wheels, operating at 4300 r.p.m.
 Rotor Sander	9″ Pad or Wire Cup Brush	3600	3300	10½	For use with sanding pads where extremely smooth finish is desired, and with wire cup brushes.
 High Production Vertical Grinder	6 x 1½ x ⅝ Cup Wheel	4700	4400	10½	A vertical machine used with cup wheels for grinding flat surfaces and welds.

The Rotor Air Tool Co. · 5704 Carnegie Avenue · Cleveland, Ohio

DOWN COME THE DETOUR SIGNS



Five lines of Mathews Roller Conveyer form the basis of this efficient handling system in the foundry of the Parker Street Castings Company at Cleveland. A special transfer car with roller bed is used in moving molds from storage lines to the pouring line.

When business ripped along with both feet on the accelerator, roundabout handling methods were not so painfully prominent . . . perhaps because the jolts and bumps of excessive costs were cushioned by a set of good shock absorbers, big production and generous profits.

But today, the detour signs are coming down. Everywhere, executives have had more time to scan cost figures . . . to realize the extreme importance of a direct right-of-way over which production may travel rapidly, safely and at minimum cost . . . . and many of these men, planning for the future as well as for the present, have selected Mathews Conveyer Systems as their new production routes.

To those executives knowing revisions necessary and desiring concrete suggestions for the most efficient handling layouts possible . . . . to those dubious of existing methods and welcoming comparative data showing what could be expected if changes were made . . . Mathews offers the services of a competent staff of conveyer engineers.

Back of this staff is an amazingly complete group of conveyer units. There's the sturdy gravity roller, pioneered by Mathews long ago. There are belt, chain and trolley conveyers, created to meet the demand for regulated movement. There are these and a host of others, all with their definite purpose.

In your modernization plans, consider Mathews Conveyer Systems. An interesting conveyer book, sent to you on request, presents ideas on how to eliminate the detours.

NEW AND IMPROVED FEATURES
of Mathews Heavy Duty Roller Conveyer

1. ***Gearlock Cone and Axle:*** Gear teeth on inside of cone and knurling on axle provide a lock preventing cone from turning on axle.
2. ***Keylock Axle:*** One end provided with upset key, fitting into corresponding slot in frame rail. Prevents axle from turning.
3. ***Protected Bearings:*** Outer end fitted with special dust-proof steel and felt washer labyrinth. Bearings can be packed in grease.
4. ***Heavy Cones and Races:*** Solid outside rings or ball races forged solid. Heavy duty cones with ample stock beneath the ball groove. Cone and rings are given a heavy case.
5. ***High Carbon Seamless Tubing:*** Heavy gauge .40 carbon steel. Walls of uniform thickness. Counterbored to receive bearings.
6. ***Rugged Frames:*** Angle iron or channel construction. Cross bracing are welded.

MATHEWS
CONVEYER SYSTEMS

Mathews Conveyer Company . . . 104 Tenth Street . . . Ellwood City, Pa.

Birmingham . . . Boston . . . Buffalo . . . Charlotte . . . Chicago . . . Cleveland Dallas . . . Denver . . . Detroit . . . Los Angeles . . . Milwaukee . . . Minneapolis New Orleans . . . New York . . . Philadelphia . . . Pittsburgh . . . St. Louis . . . San Francisco . . . Seattle . . . Mathews Conveyer Company, Limited, Port Hope, Ontario

"OK"

One successful melt is easy—but to continue day after day with high-grade melts and minimum losses is the permanent problem.

Spencer Compressors

—built on the centrifugal principle, are being used more and more every year

because

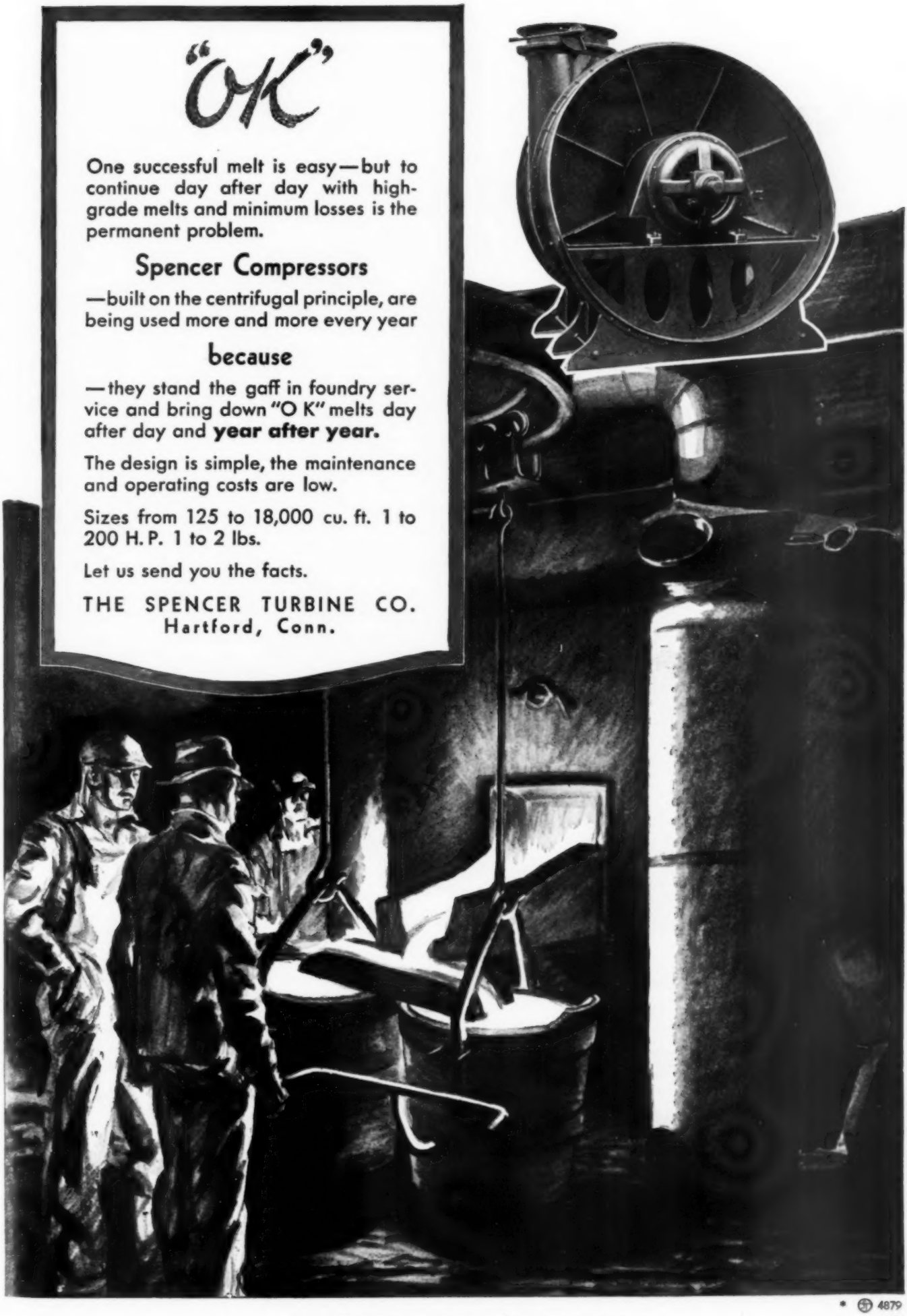
—they stand the gaff in foundry service and bring down "O K" melts day after day and **year after year.**

The design is simple, the maintenance and operating costs are low.

Sizes from 125 to 18,000 cu. ft. 1 to 200 H. P. 1 to 2 lbs.

Let us send you the facts.

THE SPENCER TURBINE CO.
Hartford, Conn.



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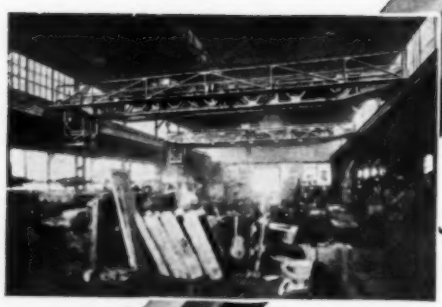
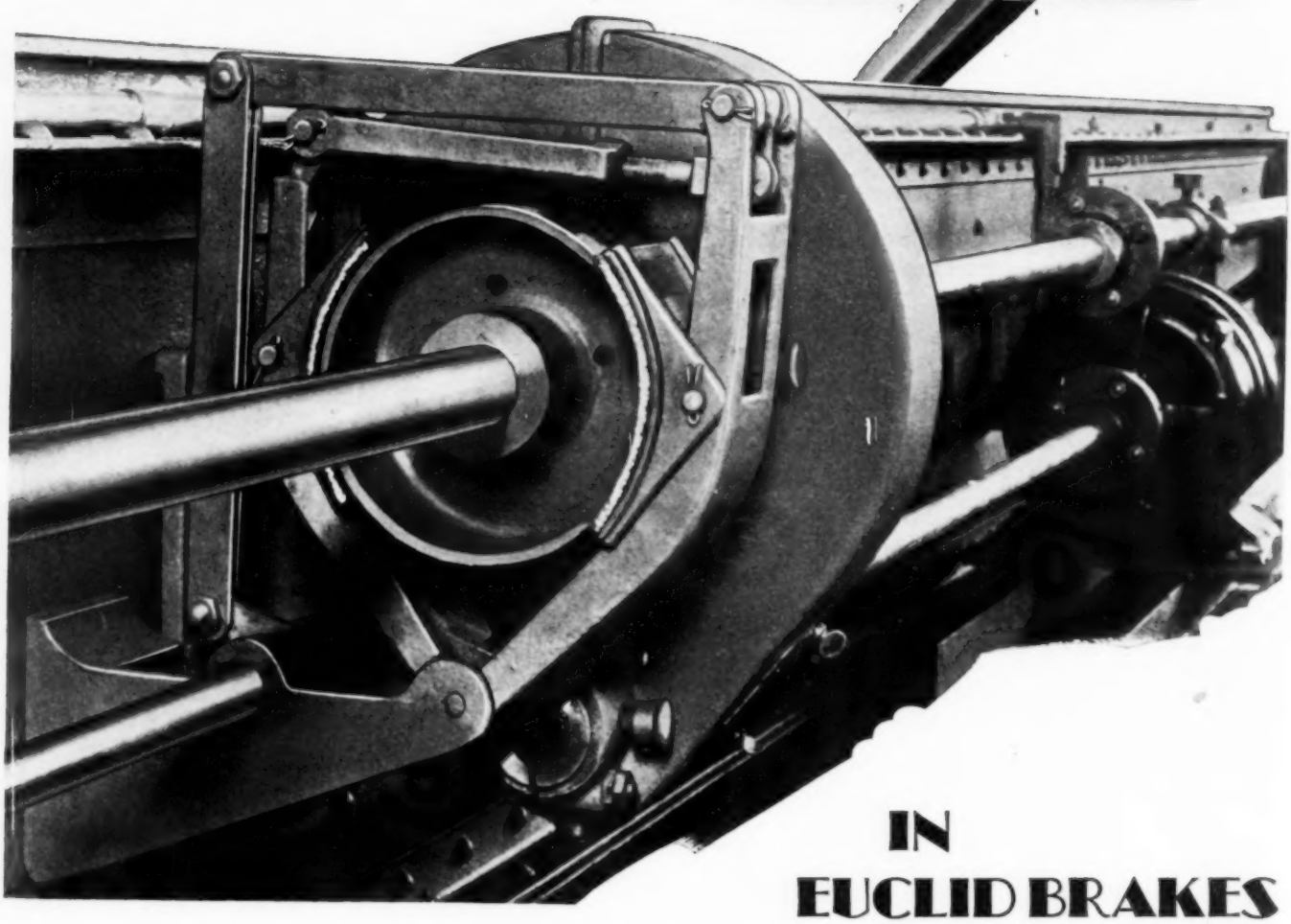
UNUSUAL SAFETY, TOO





IN EUCLID BRAKES

IN brake equipment as well as in every other detail of Euclid Crane construction, the unusually liberal factor of safety is a striking feature.

The husky, powerful brake shown above for controlling the traveling bridge, is typical of Euclid design. Of the lever type, foot-operated, it provides immediate, *positive* control regardless of load or speed.

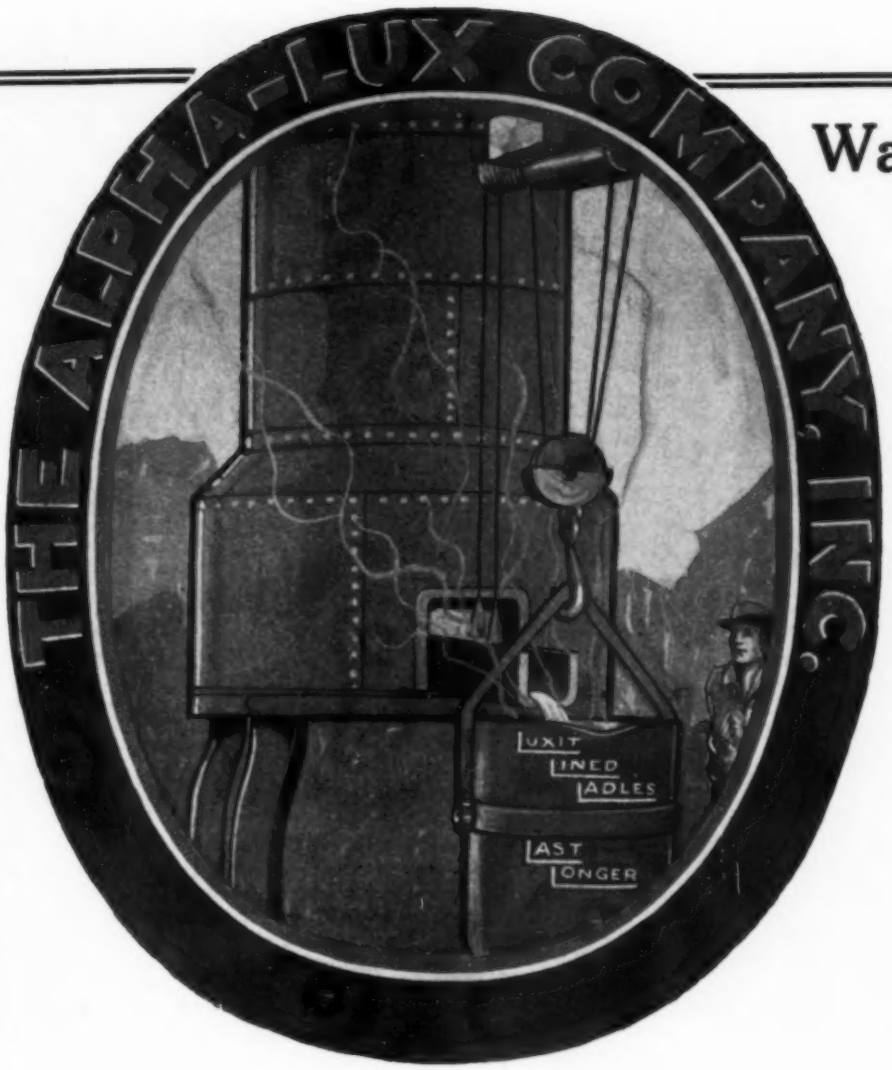
This built-in safety factor accounts not only for the ease with which Euclid equipment meets emergency loads and conditions, but also for the added years of dividends Euclid users receive in longer crane life.

Euclid cranes and hoists are available for any special type of material handling as well as in a complete range of standard types and sizes.

CRANES
EUCLID
AND HOISTS
"Raise Profits"

Write today for copy of catalog F 12

THE EUCLID CRANE & HOIST CO., EUCLID, OHIO



Want to save on Refractory ?

Use the Superior

LUXIT

on Ladles Cupolas Converters Etc.

Use Luxit as monolithic lining and for patching all kinds of furnaces, ladles, cupolas, converters, etc.

Simple to mix, easy to use—no skilled labor required.

Increases production and reduces maintenance costs by lasting longer.

Less lining required consequently lightens ladles and gives greater capacity.

Luxit is shipped dry—no freight on water—and there is a distributor near you.

Fusion Point Above 3300 F
Get the full story of Luxit—send for further particulars.

Note:—For Brass Foundries
We have especially interesting and easily applied instructions.

The Alpha-Lux Co., Inc.

192 Front St. **New York City**

INDUSTRY PREFERS P&H CRANES

...BECAUSE THEY ARE THOROUGHLY RELIABLE

AFTER all, there is just one outstanding reason for the predominance of P & H Overhead Traveling Cranes—their absolute reliability. There are other features, of course, which contribute to the preference of users. But these are secondary. The thing that has primarily influenced concern after concern to standardize on P & H Cranes, often despite lower competitive prices, is their reliability . . . reliability which results from combining the best of materials with the engineering of the most experienced crane building organization in the world.

Some of the many prominent users:

	Number of Cranes
Anaconda Copper Co.	285
Allis Chalmers Mfg. Co.	274
Bethlehem Steel Co.	246
American Smelting & Refining Co.	107
International Harvester Co.	84
Weyerhaeuser Timber Co.	82
Ford Motor Co.	77
Pennsylvania R. R.	45

If you would be interested in details of construction and operation which account for the fact that there are more P & H Cranes in use than any other make, write for the P & H Overhead Traveling Crane Catalogue.

HARNISCHFEGER CORPORATION
Established 1884
4405 W. National Avenue, Milwaukee, Wisconsin
Offices and Agents in Principal Cities

P&H CRAWLER CRANES

The P & H Corduroy (Crawler) Crane provides a material handling unit that goes anywhere over any kind of ground and handles every kind of loose material and stores. Gasoline, electric or Diesel power. Sizes range from 8 tons capacity upward.

Improve Green Sand Castings with ZIRCONIUM

GREEN sand castings treated with Zirconium show fewer pinholes than castings made of untreated steel. Grain sizes are smaller and there is less segregation of impurities at the grain boundaries. This produces a uniform texture free from hard spots, improves machinability, and reduces rejects.

You can demonstrate this and other advantages of Electromet Silicon-Zirconium and Zirconium-Ferrosilicon in your own plant. Write for complete information.

Sole Distributors

ELECTRO METALLURGICAL SALES CORP.

Unit of Union Carbide UCC *and Carbon Corporation*

Carbide and Carbon Building, 30 East 42nd Street

New York, N. Y.

Electromet Ferro-Alloys & Metals

CHROMIUM
High-Carbon Ferrochrome
(maximum 6% carbon)
Low-Carbon Ferrochrome
(in grades, maximum 0.06%
to maximum 2.00% carbon)
Chromium Metal
Chromium-Copper
Miscellaneous Chromium Alloys

MANGANESE
Standard Ferromanganese
78 to 82%
Low-Carbon Ferromanganese
Medium-Carbon
Ferromanganese
Manganese Metal
Silico-Manganese
Manganese-Copper
Miscellaneous Manganese Alloys

SILICON
Ferrosilicon 15%
Ferrosilicon 50%
Ferrosilicon 75%
Ferrosilicon 80 to 85%
Ferrosilicon 90 to 95%
Refined Silicon
(minimum 97% Silicon)
Calcium-Silicon
Calcium-Aluminum-Silicon
Calcium-Manganese-Silicon
Silicon-Copper
Silico-Manganese
Miscellaneous Silicon Alloys

TUNGSTEN

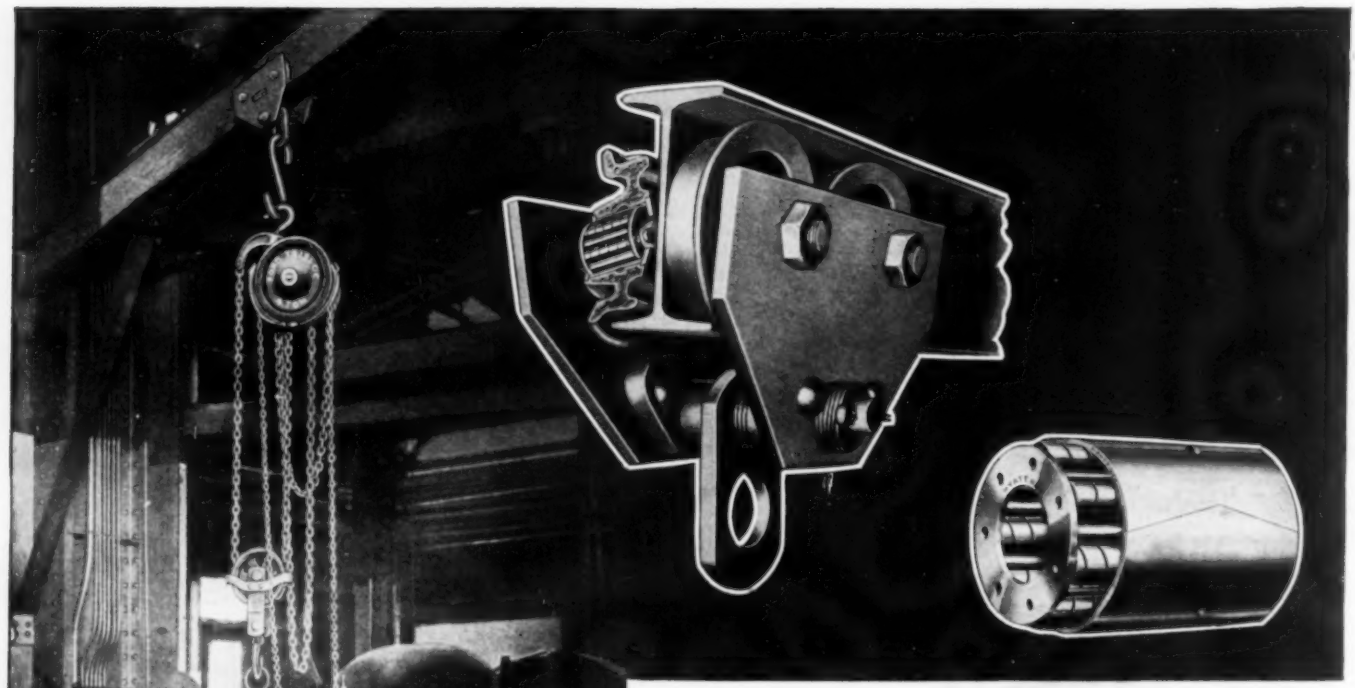
VANADIUM
All Grades

ZIRCONIUM
Aluminum-Zirconium
Ferro-Zirconium
Silicon-Zirconium
Zirconium-Ferrosilicon

Ford Tribloc Trolleys are Hyatt Protected

Ability to deliver smooth, uninterrupted performance under stress of heavy loads and continuous operation has won Hyatt an enviable position of preference with material handling equipment manufacturers everywhere.

Among these, the Ford Chain Block Company builds Hyatt protection into its trolleys to provide maximum strength and long life.



Ford Triblocs are manufactured in sizes from 1/4 to 40 tons, with a complete line of Hyatt equipped trolleys.

Carrying the load on Hyatts is assurance of freedom from bearing wear and care—freedom from delays and repairs.

Hyattized equipment is a profitable investment. For no matter where applied, Hyatt Roller Bearings offer a forward step in operating efficiency.

HYATT ROLLER BEARING COMPANY

Newark Detroit Chicago Pittsburgh Oakland

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS